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- Easy to understand
- Based on Latest Syllabus
- Rapid one shot Revision Guide
- Designed by Team of Experts
- Covers All Pharma & Non-Pharma Topics

2nd ★★ EDITION

■ Theory Book

NIPER AT YOUR FINGERTIPS

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

Scoring in NIPER MADE EASY

By

Dr. Peeyush Jaiswal
M.pharm, Ph.D.
Director
GPAT Discussion Center Pvt. Ltd.

Dr. Abhishek Tripathi
M.pharm, Ph.D.
HOD
GPAT Discussion Center Pvt. Ltd.

GDC PUBLICATION

GDC Publication
A-17, Rajaswa Colony, Ashok Nagar,
Sarkanda, Bilaspur (C.G.),
Pin : 495006

Theory NIPER At Your Fingertips
(Scoring in NIPER MADE EASY).

Second Edition

ISBN : 978-81-981310-7-2

Typesetting by :
Team GDC

Composition by :
Vidyadhar Sahu and Chandranayan Sahu

Price : ₹980

Published by :
GPAT Discussion Center Pvt. Ltd.
GDC Publication,
Bilaspur, 495001

for further Information about the products from GDC Publication

+91-6263936320, +91-9770765680
www.gdconlinetest.in | www.gdc4gpat.com
gdclive037@gmail.com

CONTENT

NIPER AT A GLANCE

Now your GPAT/GATE result have been declared you might be enjoying last day of your college life (writing slams, enjoying parties etc.) but remember that you have not still achieved your final destination because there is no place in India like NIPER for pursuing your post graduate education. So you should have proper balance between your enjoyment and study.

This Book **NIPER AT YOUR FINGERTIPS**, will make your NIPER preparation easier and more oriented. Any rank qualified ranker in GPAT, also get admission in NIPER by their hard work in rest period of time, We will prove this again in coming months.

Information About NIPER

The National Institute of Pharmaceutical Education and Research (NIPER) at S.A.S Nagar (Mohali) created as a Centre of Excellence for imparting higher education, research and development in pharmaceutical sciences and management is the first Institute of its kind in the country, The Institute was declared as an Institute of National Importance by Government of India through an Act of Parliament, notified on 26th June 1998.

NIPER conducts an entrance exam for candidates aspiring to make a career in Pharmacy by seeking admission into various Postgraduate and Doctorate level courses. It evaluates the aptitude of candidates for courses like MS (Pharm.), M Pharma, MTech (Pharm.), PhD and MBA (Pharm.).

Different NIPER across India

- NIPER, Mohali - www.niper.nic.in
- NIPER, Ahmedabad - www.niperahm.ac.in
- NIPER, Guwahati - www.niperguwahati.ac.in
- NIPER, Hajipur - www.niperhajipur.ac.in
- NIPER, Hyderabad - www.niperhyd.ac.in
- NIPER, Kolkata - www.niperkolkata.edu.in
- NIPER, Raebareli - www.niperraebareli.edu.in

NIPER Act empowers the Institute vide following Sections

Section 7(ii) "to concentrate on courses leading to masters degree, doctoral and post doctoral courses and research in pharmaceutical education". Section 7 (iii) "to hold examinations and grant degrees".

Section 32 "Notwithstanding anything contained in the University Grants Commission Act, 1956 or in any other law for the time being in force, the Institute shall have power to grant degrees and other academic distinctions and titles under this Act".

Institute is awarding degrees like Ph.D.; M.Pharm.; M.Tech. (Pharm.); M.S.(Pharm.) and M.B.A. (Pharm.) As mandated to it by Section 7 (ii), (iii) and Section 32 of the NIPER Act 1998.

The main objectives of the institutes are :

1. Toning up the level of pharmaceutical education and research by training the future teachers, research scientists and managers for the industry and profession.
2. Continuing education programmes
3. Creation of National Centres to cater to the needs of pharmaceutical industries and other research and teaching institutes
4. Collaboration with Indian industries to meet the global challenges
5. National/International collaborative research
6. Curriculum and media development
7. Study of sociological aspects of drug 'use and abuse', and rural pharmacy, etc
8. Conducting programmes on drug surveillance, community pharmacy and pharmaceutical management

NIPER JEE Highlights

EXAM PARTICULARS	EXAM DETAILS	
Name of exam	National Institute of Pharmaceutical Education and Research Joint Entrance Exam	
Conducting body	National Institute of Pharmaceutical Education and Research	
Exam Level	Postgraduate exam at the National level	
Exam Frequency	Once a year	
Mode of Exam	Computed Based Test (CBT)	
Courses offered through Entrance Exam	M.Pharm, MTech (Pharm), MBA (Pharm), and PhD	
Eligibility	• Qualified degree with a minimum 60% marks • Qualified in GPAT/GATE/NET	
Exam Fees		
Admission Test for M.S. (Pharm.) / M.Pharm. /MBA (Pharm.) courses	Gen/OBC/PwBD/EWS	3,000/-
	SC/ST	1,500/-
Admission Test for M.Tech./ M.Tech. Courses (Biotechnology / Process Chemistry / Medicinal Chemistry and Medical Devices)	Gen/OBC/PwBD/EWS	3,000/-
	SC/0.5ST	1,500/-
If any candidate willing to apply for both the programmes	Gen/OBC/PwBD/EWS	4,500/-
	SC/ST	2,500/-
Exam Duration	120 minutes (2 hours)	
No. of Papers and Total Marks	Paper-1 of 100 marks	
Question Section	**Section – A** 25% Question - General English, Aptitude, Reasoning, and General Knowledge	
	Section – B 75% Question - From the syllabus of B. Pharm. & PG degrees (MSc.) in relevant fields.	
Total Questions	200 MCQs	

Marking Scheme	• 0.5 for each correct response • -0.125 for each incorrect response • No marks for unattempted or unanswered questions
Language/Medium of Exam	English
Colleges Accepting Exam Score	NIPER (Mohali, Raebareli, Kolkata, Hajipur, Ahmedabad, Guwahati, Hyderabad)
No. of Test Cities	20 all over India (As per present data)
Official Website	http://www.niperguwahati.ac.in/ and websites of other NIPERS
Contact Details	Technical helpline email address: Helpdesk :- niperjee@niperguwahati.in

Important Dates for Admission

TENTATIVE IMPORTANT DATES FOR ADMISSION	
Commencement of online application	Check the important dates of NIPER JEE from the official website of NIPER institutes.
Last date for online application	
Downloading of the Hall-tickets	
Online NIPER JEE 2025 Examination	
Declaration of results on the website (www.niperguwahati.ac.in)	
Group discussion of MBA candidates and Physical counselling	

NIPER JEE Admission Process

The NIPER exam admission process involves the whole procedure to secure a seat via any of the entrance examinations. The process involves filling in application forms to attend the counselling and submitting the admission fee. Below are the brief steps of the admission process

- ✓ **Registration/Application form filling:** Candidates have to provide their personal details academic details, upload their recent passport-size photograph and the scanned image of their signature, and submit the application fee to conclude the process.
- ✓ **Download the Admit Card:** The conducting body will release the admit card at least ten or seven days before the entrance exam, and candidates have to download and take a printout of the admit card.
- ✓ **Appear for the entrance exam:** The candidates must appear for the entrance exam by reporting to the allotted centre at the prescribed time and date. Candidates will not be allowed to enter the exam hall without producing a hard copy of the admit card.
- ✓ **Attend the counselling:** Candidates have to attend the counselling before a personal interview. According to the choice of selected college, candidates will be allotted seats as per their merit.
- ✓ **Fee submission and attending classes:** After the seats are allotted, candidates have to submit the admission fee and the tuition fee at the allotted institutes and attend the classes on the prescribed dates.

How to Fill NIPER JEE Exam Application Form

NIPER has begun the application process. Candidates can start filling out the NIPER JEE application form in online mode at the official website of NIPER. Candidates can apply by following the steps listed below:

- Visit the official website of NIPER, niperguwahati.ac.in or other NIPER website who conducted the exam
- Click on the registration link and create a new user ID and password
- Candidates have to log in to their account by clicking the link sent on the registered mail ID post the registration process.
- Candidates have to provide all the details in the application form, such as Name, Address, Date of Birth, Father's Name, Category, and Subject applied for.
- After filling out the application form, candidates must pay the application fee.
- The application fee is payable via Credit or Debit card, Net Banking or E-Challan
- A confirmation page will appear after the payment is done, and candidates now have to submit and initiate a digital signature.
- Candidates now have to upload their photo ID proof and Address proof, Tenth, and Twelfth Mark sheet, Reservation certificate (if applicable), Medical certificate (if applying under handicapped category), valid GATE, GPAT or NET Scorecard (if applicable), and Passport-sized Photograph along with the digital signature.
- Candidates must take a printout of the filled application form for future reference.

How to Check NIPER JEE Exam Result

The conducting body of the exam will announce the NIPER JEE result on its official website. Candidates can access the result online and download the scorecards/result in PDF format.

Candidates can refer to the step-by-step guide on how to view and download the NIPER JEE exam result below:

- Visit the NIPER's official website, *www.niperguwahati.ac.in* or other NIPER Website
- Click on the 'NIPER JEE' button
- Click on 'NIPER JEE– Result for MBA Programme' and 'NIPER JEE - Result for M.S.(Pharm.)/M.Pharm./ M.Tech.(Pharm.) Programme' link in the NIPER exam result Section at the top.
- The result will appear on the Screen in PDF format, and candidates can find their AIR by searching for their Application Number using Ctrl+F.

NIPER JEE Counselling

- After the results are announced, shortlisted candidates will be contacted for an interview and group discussion.
- A new merit list will be published based on the combined marks of the online exam, interview, and community discussion.
- Candidates who are shortlisted will be able to engage in the counselling.
- Candidates will be asked to fill out their college preferences during the counselling.

Documents to be Submitted

During the counselling process, documents will be checked. Please see the list of necessary documents below.

- Matriculation Certificate (Proof of age and correct name)
- Mark sheets of all semesters/ years of the qualifying degree
- GPAT/ GATE/ NET score card (Wherever applicable)

- Admit card of the entrance exam
- Certificate of reservation (If applicable)
- Certificate of income (If applicable)
- Certificate of disability (If applicable)
- Medical Certificate
- Sponsorship certificate from the employer in case of Government/ Industry sponsored candidates.
- Documentary proof supports the NRI status (Only for MBA Pharm.)
- Affidavit to be provided in the form of Undertaking
- Undertaking to be given by the parents regarding ragging for their wards to abide by the rules of NIPER
- Attested copy of Aadhar Card

Academic Program

The institute offers the students various courses viz. M. Pharm, M. Tech. (Pharm), M.S (Pharm.) and Ph.D. Programmesin various departments every year.

First bring good rank in entrance

Specialization branch you can select at time of counseling.

ACADEMIC PROGRAM: AVAILABILITY AT VARIOUS NIPERs AND QUALIFYING DEGREES
M.S.(Pharm.); M.Pharm.; M.Tech. (Pharm.), M.B.A. (Pharm.)
Departments/Disciplines, Offering NIPERs and Eligibility Criteria

Medicinal Chemistry	**M.S. (Pharm.)**
Offering NIPERs	Ahmedabad, Guwahati, Hyderabad, Kolkata, Raebareli, S.A.S. Nagar
Qualifying Degrees	B. Pharm. / M.Sc. (Organic Chemistry)
Natural Products	**M.S. (Pharm.)**
Offering NIPERs	Ahmedabad, Hyderabad, Kolkata, S.A.S. Nagar
Qualifying Degrees	B.Pharm. / M.Sc. (Organic Chemistry)
Traditional Medicine	**M.S. (Pharm.)**
Offering NIPERs	S.A.S. Nagar
Qualifying Degrees	B.Pharm./ B.A.M.S./ M.Sc. (Botany)
Pharmaceutical Analysis	**M.S. (Pharm.)**
Offering NIPERs	Ahmedabad, Guwahati, Hajipur, Hyderabad, Kolkata, S.A.S. Nagar, Raebareli
Qualifying Degrees	B.Pharm./ M.Sc. (Organic/Analytical Chemistry)
Pharmacology & Toxicology	**M.S. (Pharm.)**
Offering NIPERs	Ahmedabad, Guwahati, Hajipur, Hyderabad, Kolkata, Raebareli, S.A.S. Nagar
Qualifying Degrees	B.Pharm./ B.V.Sc./ M.B.B.S

Regulatory Toxicology	**M.S. (Pharm.)**
Offering NIPERs	Raebareli, S.A.S. Nagar
Qualifying Degrees	B. Pharm./ B.V.Sc./ M.Sc (Pharmacology/ Toxicology /Life Sciences/Biochemistry/Medical Biotechnology/ Zoology)/ M.B.B.S
Pharmaceutics	**M.S (Pharm.)**
Offering NIPERs	Ahmedabad, Guwahati, Hajipur, Hyderabad, Kolkata, Raebareli, S.A.S. Nagar
Qualifying Degrees	B. Pharm.
Pharmacoinformatics	**M.S. (Pharm.)**
Offering NIPERs	Hyderabad, Kolkata, S.A.S. Nagar
Qualifying Degrees	B.Pharm./ B.Tech. (Bioinformatics)/ M.Sc. (Organic/ Physical/ Pharmaceutical Chemistry/Biochemistry/ Biotechnology/Molecular Biology/Bioinformatics/ Microbiology)
Regulatory Affairs	**M.S. (Pharm.)**
Offering NIPERs	Hyderabad, Raebareli
Qualifying Degrees	B.Pharm./ B. Tech./B.E. (Biotechnology/ Biomedical Engineering/Chemical Engineering or equivalent), M.B.B.S / BDS / B.V.Sc./ M.Sc. (Biotechnology/ Microbiology/Food Science/ Life Sciences/ Chemical Sciences/Pharmacology/ Toxicology)
MASTER OF PHARMACY (M.PHARM) PROGRAMMES	
Pharmaceutical Technology (Formulations)	**M.Pharm.**
Offering NIPERs	Guwahati, S.A.S Nagar
Qualifying Degree	B.pharm.
Pharmacy Practice	**M.Pharm**
Offering NIPERs	Guwahati, Hajipur, S.A.S Nagar
Qualifying Degree	B.pharm.
Clinical Research	**M.Pharm**
Offering NIPERs	S.A.S Nagar
Qualifying Degree	B.pharm.
MASTER OF TECHNOLOGY PROGRAMMES	
Biotechnology / Pharmaceutical Technology (Biotechnology)*	**M.Tech**
Offering NIPERs	Ahmedabad, Guwahati, Hyderabad, Kolkata, Raebareli, S.A.S. Nagar
Qualifying Degree	B.Pharm./M.Sc. (Biological Sciences) / B.Tech (Biotechnology) M.Sc. (Life Science)

Pharmaceutical Technology (Process Chemistry)/ Medicinal Chemistry#	M.Tech
Offering NIPERs	Ahmedabad, Hyderabad, S.A.S. Nagar
Qualifying Degree	B.Pharm./M.Sc. (Organic Chemistry), B.Tech (Chemical Engineering or equivalent)
Medical Devices	**M.Tech**
Offering NIPERs	Ahmedabad, Guwahati, Hyderabad, Kolkata, S.A.S. Nagar
Qualifying Degree	B. Pharm./ M.B.B.S / BDS / B.V.Sc / B.E or B.Tech (Biotechnology / Biomedical / Biophysics / Electronics / Instrumentation / Mechanical / Biochemical / Health Sciences or allied subjects) / 4-year BS course (Chemistry/ Mathematics & Computing/ Physics/ Programming/Data Science) / Post Graduation in Chemical Sciences / Life Sciences / Material Sciences / Physical Sciences / Biotechnology / Biomedical / Biophysics / Electronics / Instrumentation / Biochemical / Health Sciences, Medical science & Technology or allied subjects as applicable in GATE/ NET.
MASTER OF BUSINESS ADMINISTRATION PROGRAMMES	
Pharmaceutical Management	**Pharmaceutical MBA**
Offering NIPERs	S.A.S Nagar
Qualifying Degree	B.Pharm./B.Tech (Chemical Engineering or Equivalent) M.Sc. (Chemical/Life Science)

Seat Matrix of Master Programmes at NIPERs

S. N.	COURSE/DISCIPLINE	SEATS
	Master of Science (M.S. Pharm.)	
1.	Medicinal Chemistry	122
2.	Natural Products	58
3.	Traditional Medicine	05
4.	Pharmaceutical Analysis	108
5.	Pharmacology & Toxicology	140
6.	Regulatory Toxicology	21
7.	Pharmaceutics	142
8.	Pharmacoinformatics	37
9.	Regulatory Affairs	18
	Master of Pharmacy (M. Pharm.)	
10.	Pharmaceutical Technology (Formulations)	23
11.	Pharmacy Practice	35
12.	Clinical Research	09
	Master of Technology (M. Tech.)	
13.	Biotechnology / Pharmaceutical Technology (Biotechnology)*	120
14.	Pharmaceutical Technology (Process Chemistry)/ Medicinal Chemistry#	40
15.	Medical Devices	62
	Master of Business Administration (M.B.A Pharm.)	
16.	Pharmaceutical Management	50
	Total Seats (7 NIPERs)	**990**

NIPER S.A.S NAGAR

Indian Pharma Industry has been a global leader in generic drugs. In order to acquire leadership position in drug discovery and development and to continue to excel in the formulations and Biological Sciences, the Government of India recognized that the human resources/talent pool is very critical. Thus, the Government of India set up the "National Institute of Pharmaceutical Education and Research (NIPER) at S.A.S. Nagar Mohali" in 1991 as a registered society under Society Registered Act, 1860. NIPER S.A.S Nagar has secured 1st rank in India, 7th rank in Asia and 44th rank globally according to QS World University Rankings in Pharmacy and Pharmacology subject category. NIPER has also been ranked 4th in MoE, National Institute Ranking Framework (NIRF) in pharmacy category. NIPER S.A.S. Nagar is a member of the Association of Indian Universities. Since its inception, 3395 Master's, 744 MBA, and 404 Ph.D. students have graduated from NIPER S.A.S. Nagar. Institute is involved in cutting-edge research in various nationally recognized disease areas, very well documented and exemplified by the publication of 2984 research papers and filing of 237 patents out of which 131 have been granted and 5 trademarks.

The aims of NIPER S.A.S. Nagar are achieved by :

1. Teaching activities M.S. (Pharm.), M.Tech. (Pharm.), MBA (Pharm.) & Ph.D. courses are being offered.
2. Research and Development activities - Sponsored research projects/consultancy/Project handling/upscaling.
3. Support to industry - The Institute provides support to the industry through its service centres viz Library & Information Centre, Central Instrumentation Laboratory, National Toxicology Centre, Small & Medium Pharmaceutical Industry Centre, Technical Development Centre, National Bioavailability Centre, NPIE etc.)

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	22
	Natural Products	18
	Traditional Medicine	5
	Pharmaceutical Analysis	9
	Pharmacology & Toxicology	24
	Regulatory Toxicology	9
	Pharmaceutics	21
	Pharmacoinformatics	17
M.Pharm	Pharmaceutical Technology (Formulation)	7
	Pharmacy Practice	9
	Clinical Research	9
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	30
	Pharmaceutical Technology (Process Chemistry)	10
	Medical Devices	10
M.B.A. (Pharm)	Pharmaceutical Management	50
TOTAL SEATS		250

NIPER AHMEDABAD

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	20
	Natural Products	20
	Pharmaceutical Analysis	20
	Pharmacology & Toxicology	20
	Pharmaceutics	20
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	20
	Pharmaceutical Technology (Process Chemistry)	10
	Medical Devices	20
TOTAL SEATS		150

NIPER HAJIPUR

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Pharmaceutical Analysis	12
	Pharmacology & Toxicology	18
	Pharmaceutics	20
M.Pharm	Pharmacy Practice	10
TOTAL SEATS		60

NIPER HYDERABAD

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	20
	Natural Products	10
	Pharmaceutical Analysis	20
	Pharmacology & Toxicology	25
	Pharmaceutics	25
	Pharmacoinformatics	10
	Regulatory Affairs	10
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	20
	Pharmaceutical Technology (Process Chemistry)	20
	Medical Devices	10
TOTAL SEATS		170

NIPER GUWAHATI

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	25
	Pharmaceutical Analysis	27
	Pharmacology & Toxicology	22
	Pharmaceutics	22
M.Pharm	Pharmaceutical Technology (Formulation)	16
	Pharmacy Practice	16
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	20
	Medical Devices	12
TOTAL SEATS		160

NIPER KOLKATA

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	18
	Natural Products	10
	Pharmaceutical Analysis	10
	Pharmacology & Toxicology	16
	Pharmaceutics	16
	Pharmacoinformatics	10
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	10
	Medical Devices	10
TOTAL SEATS		100

NIPER RAEBARELI

Courses	Disciplines	No. of Seats
M.S. (Pharm)	Medicinal Chemistry	17
	Pharmaceutical Analysis	10
	Pharmacology & Toxicology	15
	Regulatory Toxicology	12
	Pharmaceutics	18
	Regulatory Affairs	8
M.Tech. (Pharm)	Pharmaceutical Technology (Biotechnology)	20
TOTAL SEATS		100

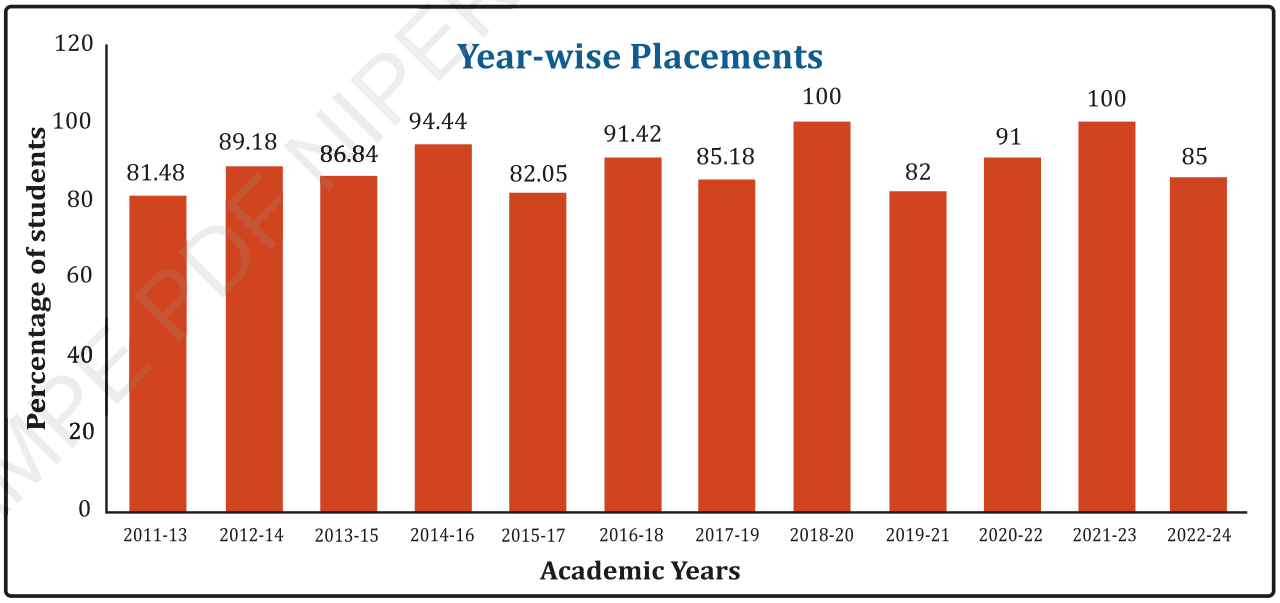
Note : Seats may subject to change

Highlights From The Placement Cell

❑ NIPER AHMEDABAD PLACEMENT STATISTICS

Batch	Total Students	Higher Studies	Opted for Placement	% of Placement
2015-17	54	2	52	92.3%
2016-18	69	9	60	90.0%
2017-19	72	25	47	97.9%
2018-20	96	18	78	83.3%
2019-21	107	22	85	98.8%
2020-22	142	25	117	95.7%*
2021-23	151	25	126	93.65%
2022-2024	164	28	136	90.4%

❑ NIPER GUWAHATI PLACEMENT STATISTICS



❑ NIPER HYDERABAD PLACEMENT STATISTICS

Year	No. of Students Registered	No. of Students Placed	No. of Students Opted for Higher Studies	% of Placement
2017	105	84	14	92.3%
2018	110	90	15	94.7%
2019	119	95	22	97.9%
2020	132	106	26	80.30%
2021	148	131	17	88.51%
2022	159	140	19	88.05%
2023	180	155	25	86.11%

❑ NIPER RAEBARELI PLACEMENT STATISTICS 2024

Discipline	Students Opted for Placement	Students Placed	% of Placement
Medicinal Chemistry	26	15	57.69%
Pharmaceutics	23	11	47.83%
Pharmacology & Toxicology	17	11	64.71%
Regulatory Toxicology	08	08	100%
Biotechnology	11	04	36.36%

NIPER Fee Structure

❑ M.S.(PHARM.), M.PHARM., M.TECH (PHARM.)

Onetime payment of charges	General / OBC / EWS (Rs.)	SC/ST (Rs.)	Govt./Industry sponsored. (Rs.)*
Admission Fee	5,000	5,000	-
Alumni Fund	8,500	8,500	-
Hostel Admission	3,496	3,496	-
Group Insurance (for 2 years)	4,000	4,000	-
Security Amount (Refundable) Note: Refundable after successful completion of the course	27,500	27,500	-
Placement Fee	4000	4000	-
TOTAL (A)	**52,496**	**52,496**	**75,698**
CHARGES PAYABLE FOR EACH SEMESTER			
Tuition Fee	26,022	0	-
Examination/Evaluation Fee	1,150	1,150	-
Registration Fee	1,392	1,392	-
Sports	1,150	1,150	-
Computer Contingency	1,150	1,150	-
Medical Charges	1,100	1,100	-

Sports	1,150	1,150	-
Computer Contingency	1,150	1,150	-
Medical Charges	1,100	1,100	-
Hostel Rent	4,593	4,593	-
Electricity Charges	3,061	3,061	-
Benevolent fund	696	696	-
Laboratory Fee	11,483	11,483	-
Library Fee	1,531	1,531	-
TOTAL (B)	**53,328**	**27,306**	**92,535**
TOTAL CHARGES PAYABLE			
Payable on Admission [Sem-1 (A+B)]	**1,05,824**	**79,802**	**1,68,233**
Payable for subsequent semesters (B)	**53,328**	**27,306**	**92,535**

❑ M.B.A. (PHARM.)

Onetime payment of charges	General / OBC / EWS (Rs.)	SC/ST (Rs.)	Govt./Industry sponsored. (Rs.)*
Admission Fee	5,000	5,000	-
Alumni Fund	8,500	8,500	-
Hostel Admission	3,496	3,496	-
Group Insurance (for 2 years)	4,000	4,000	-
Security Amount (Refundable) Note: Refundable after successful completion of the course	27,500	27,500	-
Placement Fee	4000	4000	-
TOTAL (A)	**52,496**	**52,496**	**75,698**
CHARGES PAYABLE FOR EACH SEMESTER			
Tuition Fee	1,11,968	0	-
Examination/Evaluation Fee	1,150	1,150	-
Registration Fee	1,392	1,392	-
Sports	1,150	1,150	-
Computer Contingency	1,150	1,150	-
Medical Charges	1,100	1,100	-
Hostel Rent	4,593	4,593	-
Electricity Charges	3,061	3,061	-
Benevolent fund	696	696	-
TOTAL (B)	**1,26,260**	**14,292**	**2,30,294**
TOTAL CHARGES PAYABLE			
Payable on Admission [Sem-1 (A+B)]	**1,78,756**	**66,788**	**3,05,992**
Payable for subsequent semesters (B)	**1,26,260**	**14,292**	**2,30,294**

Study Guidelines

There will be a common paper for all Masters Programs including M.B.A. (Pharm.). The question paper will consist of 200 objective multiple type choice questions. The level of questions will be of B. Pharm.and M.Sc (relevant field). Duration of the examination will be 2 hours.

Well questions will be very easy so no need to go in depth of the topic, which clearly indicates that time management, is very important to get success in NIPER entrance. Understanding the question quickly is very important to pick the right choice. It is wise to leave the question if you do not know the answer perfectly. Chemistry, Pharmacology, Pharmacognosy, Biotechnology, Pharmaceutical analysis are the core subjects from which questions are being asked. There is no need to worry about Medicinal Chemistry and Pharmaceutical Jurisprudence as in GPAT, basic concepts based questions are asked M. Pharm branches and M.B.A. has a common entrance paper. So read some GK, GS, Pharma management, English language special Synonym and Antonym, Pharma News and Pharma Thrust area as given in the Book. Questions from various topics in a particular subject can vary from year to year, as exams are designed to test a student's understanding and knowledge of the subject matter. Even if the same topic is covered in different years, the questions asked may be different, and the level of difficulty can also vary.

GPAT and NIPER JEE Exam

GPAT EXAM	NIPER JEE EXAM
Computer-based online exam, Duration (3 hours), 125 MCQs (Max. marks -500)	Computer-based online exam, Duration (2 hours), 200 MCQs (Max. marks -100)
You will have 1.44 minutes per question (Rereading and rethinking is possible)	You will have 36 Sec per question (Speed and accuracy are must needed)
Mostly, questions are asked, which re- quire application of basic knowledge and logic, to reach the correct answer.	Mostly, questions are asked directly, which require absolute basic knowledge to reach correct options, except some aptitude type questions, which require a logical way to answer.
Exam contains some time taking questions, requires more time to solve i.e. :– • **Match the following** • **Statement based** • **PQRS Questions** • **Assertion-Reason** • **Conceptual based MCQ**	Exam contains mostly one liner & straight forward questions (Less time Consuming) Requires basic knowledge to reach correct option
Syllabus is known and totally based on basic pharma knowledge	Syllabus, although same as GPAT, apart from pharma knowledge, questions are asked related to:- • **Mental Aptitude, English** • **General Knowledge** • **Business Processing** • **Indian Company, Banking, Acts & Rules** • **Business Management etc.**
Questions from Pharmaceutics, Pharmaceutical engineering, Physical Pharmacy and Biopharmaceutics are asked in depth.	Questions are more related to basics of dosage form and new drug delivery systems, polymers etc.
Chemistry all topics are very important and questions are asked related to structure, IUPAC, Basic rings, SAR, Synthesis.	Basics of Organic chemistry are important and questions are asked regarding name of reactions, application of basic synthetic reagents, general rules and concepts of stereochemistry.

Approximately, 20% questions are asked from Pharmacology.	Approximately, (15% questions are asked from Pharmacology, which mainly includes • **Molecular pharmacology** (types of receptors, transduction mechanisms and secondary messenger concepts) • **Drug classification** • **Mechanism of Action** • **Specific side effect** • **Drug interactions & contraindications, uses.**
General pharmacognosy and Microscopy, Chemical test, Chemical constituents, Chemical test	Questions are more or less similar to GPAT, mainly regarding :- • **Biological sources** • **Active constituents** • **Biogenetic pathway (alkaloids) and** • **Phytochemistry and Marine Drugs.**
Basic theory and instrumentation related questions are asked from analysis	Instrumental part is less important, but thorough knowledge of basic principles of all instrumental methods of analysis is required. EMR Range, Chromatography
Less numbers of questions are asked from Biochemistry and rarely on Biotechnology.	**In Biochemistry, more stress is given on :-** • **Carbohydrates** • **Amino Acids** • **Proteins and Peptides, Nucleic Acids** • **Enzymes, Basic Cycles.** **Biotechnology part related to :-** • **Proteins and peptides** • **Genetic engineering**
Questions related to current affairs in science, Reasoning aptitude, English and pharma recent news have not been asked yet	2-3 questions related to pharma news, which includes latest FDA approved drugs, company's brand products and latest Nobel prize winners, asked in the examination.

GPAT Discussion Center Pvt. Ltd. | www.gdconlinetest.in, www.gdc4gpat.com | gdcgpat037@gmail.com | 8602227444, 9770765680
ALLAHABAD | BILASPUR | BHILAI | RAIPUR | NAGPUR | BHOPAL | INDORE | PUNE | NASHIK | DELHI | GHAZIABAD | BHUBANESWAR | BRAHMAPUR | MUMBAI

Syllabus

The NIPER does not have an official syllabus for its entrance examination. However, we have gathered information from our team and previous NIPER students to provide an expected syllabus. Our study materials and model question papers can assist in reviewing the subjects and practicing time management. If you aim to achieve a good rank in the NIPER entrance exam, it is essential to plan and prepare accordingly. Let us now discuss the preparation required for each subject in detail.

ORGANIC CHEMISTRY AND BULK DRUGS

1. IUPAC nomenclature, R and S nomenclature, E and Z isomerism, atropiisomerism, Conformations laws.
2. Hybridization, aromaticity, Huckel's rule reaction mechanisms- Electrophilic, Nucleophilic, SN1, Sn2, SNi, Elimination E1, E2 etc
3. Ester hydrolysis, Aac1 Aac2..all eight mechanisms (Jerry march) Markovnikoves rule with examples, Bredts rule, Stereoselectivity, stereospecificity, regioselectivity, chemoselectivity, chirality, stereochemistry, conformations, rearrangements, acids and bases.
4. Imine-enamine Tautomerism, keto-enol tautomerism, pericyclic reactions, racemic mixture, Resolution methods.
5. Amino acids, proteins, various methods for amino acid detection, Ninhydrin test, peptide sequencing, structures of amino acids, essential and nonessential amino acids.
6. Introduction to thermal methods of analysis like, TGA, DSC, DTA etc.
7. Carbohydrates, osazone test, mutarotation, etc.
8. Various Heterocycles, Heterocycle synthesis, reactions.
9. Introduction to Redox reactions.
10. Spectroscopy: (basics specially): Very very IMP topic. NMR, and C-NMR ranges from Morrison & Boyd or Pavia Mass -Basic concepts about various peaks M+1, molecular ion, base peak etc. (Silverstein) IR - Frequencies of various groups specially carbonyls. UV.
11. Chromatography: Details of every chromatographic method.
12. Reaction kinetics, first second third and pseudo first order reactions, radio labeling for determination of mechanism.
13. Common condensation reactions like Aldol, Claisen, Perkin, Dickmann, Darzen etc.
14. Other reactions like Cannizarro's reaction, Prins reaction, especially reactions of carbonyl compounds.
15. Oxidizing & reducing agents like sodium borohydride, chromic acid & their use in named reactions
16. Stereochemistry chiefly very important.
17. UV ranges, IR delta values, NMR peaks, Numericals

✍ Important study points

- Computational drug design and molecular modeling: only few concepts need to be cleared.
- **"Mechanism of Chemical Reactions'** from O.P. Tandon
- **STEREOCHEMISTRY** is very important as NIPER JEE point of view
- **In name reaction,** remember **the name, starting product, catalyst, intermediate and end product.** No need to remember mechanisms and every step in detail.
- **Carbohydrates and Amino acids chemistry** can be covered from Satyanarayana biochemistry book.
- **Ester hydrolysis** should be covered. One question is asked on this every year.
- **Important books** are Morrison and Boyd, Finar, Bahl and Bahl

PHARMACOGNOSY AND NATURAL PRODUCTS

In natural products more stress should be given on phytochemistry part rather than biological aspects.

1. Methods of extraction, isolation and characterization of natural products. Various separation techniques used for isolation of natural products.
2. Biosynthetic pathways.
3. Primary metabolites, their examples.
4. Secondary metabolites, various classes of secondary metabolites (e.g. Alkaloids, glycosides, tannins, lignans, saponins, lipids, flavonoids, coumarins, anthocyanidines etc.). Here most imp. Part is chemistry of these classes.
5. Important therapeutic classes: antidiabetics, hepatoprotectives, immmunomodulators, neutraceuticals, natural products for gynecological disorders, anti-cancer, anti-viral (mainly anti HIV), adaptogens etc.
6. Dietary antioxidants, Marine natural products, Plant growth regulators.
7. Spectroscopy: Basic concepts of UV, NMR, IR and Mass spectroscopy. Give more stress on IR and NMR.
8. Stereochemistry: Basic concepts.
9. Fischer, sawhorse and newmon projection formulas.
10. Biological sources of important classes of natural products. (Selected ones only)
11. Standardization of natural products.
12. What is difference between natural products and pharmacognosy?
13. Natural products as anti viral & anti cancer agents with examples.

✍ Important study points

- Biological sources of selected ones should be studied only, **especially of indigenous origin.** Focus on Important drugs only.
- **Microscopy See only types of stomata, trichomes etc,** chemical tests of all from Kokate and Khandelwal book
- Synonym, Important chemical constituents and Cultivation and collection where needed

PHARMACOLOGY AND TOXICOLOGY

1. Pharmacokinetics, pharmacodynamics, pharmacological effect, desired, undesired, toxic, adverse effects.
2. Bioavailability, bioequivalence, various factors of ADME. (From Bramhankar)
3. Drug metabolism: various pathways and other details.
4. Drug interactions, agonist, antagonist, partial agonist, protein binding, drug distribution, distribution volume, excretion pathways etc.

5. Pharmacological screening: general principles, various screening models, screening methodologies (in vitro and in vivo tests).
6. Mechanism of drug action, drug-receptor interaction.
7. Various adrenergic, cholinergic and other receptors
8. Detailed study of CNS pharmacology
9. Study of basis of threshold areas of work in NIPER in pharmacology dept. mentioned in brochure.
10. Diseases: study of the pharmacology of the diseases and drugs used with mode of action especially of diabetes, malaria, leishmaniasis, TB, hypertension, myocardial ischemia, inflammation, and immunomodualtion.
11. Chemotherapy and pathophysiology- knowledge of antibiotics, their mode of action and the microorganisms responsible for various common diseases.
12. Bioassay methods, various requirements. Brief knowledge of the statistical tests.
13. Basic mechanism of all drugs with major side effects & classification.
14. Receptors classification with examples.

Important study points

- MOA, toxicity, classification, adverse effects and specific use is very important do know (K.D. Tripathi),
- Drug interaction
- Syndrome

PHARMACEUTICS AND FORMULATION (PHARMACEUTICAL TECHNOLOGY)

1. Drug delivery systems (DDS): NDDS models, osmotic pumps, various release patterns eg.Controlled release, delayed release. Sustained release etc. order of release. Oral controlled DDS, factors affecting controlled release.
2. Carriers in DDS: polymers and their classification, types, carbohydrates, surfactants, proteins, lipids, prodrugs etc.
3. Transdermal drug delivery systems (TDDS): principles, absorption enhancers, evaluation of TDDS.
4. Parenterals: requirements, advantages, disadvantages, release pattern, route of drug delivery.
5. Drug targeting: microspheres, nano particles, liposomes, monoclonal antibodies, etc.
6. Preformulation detailed.
7. Complexation, solubilization, polymerization, viscosity measurements.
8. Dosage form development- stages, implications of dosage form.
9. Additives of formulation, types, examples, advantages, disadvantages, drug excepient interaction, incompatibility, various types of incompatibilities.
10. Dosage forms: solid (tablets, capsules, pills etc), liquid (emulsion, suspension etc), sterile (injectables), aerosols. Principles, advantages, disadvantages and problems.
11. Coating - in detail.
12. Packaging: materials, labeling etc. Types of containers (Tamper-proof containers)
13. In process controls, Product specification, documentation.
14. Compartmental modeling. (From Bramhankar)
15. Bioavailability, bioequivalence studies. Methods of improvement of oral bioavailability.
16. Evaluation of formulation, principles and methods of release control in oral formulations.

✍ Important study points

- **Preformulation study in detail from Lachman,** focus more on **bulk characterizations,** specially **amorphous, crystalline,** polymorphism, solvates, hydrates, **crystal habits, mesophase, surface area, aggregation, agglomeration,** complexation, **solubilization, polymerization**
- Calculations, posology, weights and measures and Latin names must be remembered.
- All **tables of Lachman and Martin.** Units are very important. **(You can refer GDC Digesters)**
- Regulatory aspects covered from Ansel and all unit operations (Do from Lachman) are recommended.
- **Read NDDS chapter minutely.**
- **Polymers are very important. Their name, class,** monomer unit, use should be remembered.
- **Basic concepts of physical pharmacy** should be clear, H-bonds, who invented polymorphism, number of polymorphs of particular drug, **what are xerogels, solubility of β-cyclodextrin,** etc. Follow Martin's book.

PHARMACEUTICAL ANALYSIS

1. Stability testing of pharmaceuticals, various stability tests, kinetic studies, shelf life determination, thermal stability, formulation stability.
2. Various analytical techniques
3. Tests: physical and chemical tests, limit tests, microbiological tests, biological tests, disintegration and dissolution tests.
4. Spectroscopic methods; UV, NMR, IR, MS, GCMS, FT-IR, FT-NMR, ATR (Attenuated Total Reflectance), FT-Raman- basics and applications.
5. Thermal techniques: DSC, DTA, TGA, etc.
6. Particle sizing: law of diffraction.
7. Electrophoresis: capillary electrophoresis.
8. Chromatography- detailed.
9. QA and QC: GLP, TQM, ISO system.
10. Preformulation, cyclodextrin inclusion compounds
11. Solubility: pH, pka, surfactant HLB values, Rheology.
12. Crystallinity, polymorphism, solvates and hydrates, crystal habits, porosity, surface area flow properties.
13. Dosage forms, Stages of dosage form development
14. Osmolality, osmolarity, osmotic pressure, conductivity, Preservatives, Media for bioassay.

✍ Important study points

- Principle and theory involved in various **techniques is sufficient**
- Types of chromatography do in **brief (only concept)**
- **Focus more on spectroscopy, especially UV, IR. NMR and mass,**
- Give attention to spectral analysis, **remember IR and NMR values thoroughly**
- For quality control related topics, see only basic understandings. Don't go into details.
- **Visit the website for ICH guidelines.**

PHARMACEUTICAL BIOTECHNOLOGY

1. **Enzyme :** Active site, Functional groups, Enz-Sub complex, Co-factors, Michaelis-menten eqn, Enzyme inhibition, Isoenzymes, Allosterism, Mechanism of action of some selected enzyme (Chymotrypsin, Trypsin). (Read from **Zubey**)
2. DNA replication, Transcription and Translation
3. **Recombinant DNA technology :** Bacterial transformation, transduction, etc. PCR, Southern, Northern blotting, Plasmid-Vector concept. (Read Microbiology-Tortora chapter on r-DNA technology).
4. **Immunology :** Concepts of Innate/ Adaptive/ immunity, epitope. Hypersensitivity reactions. ELISA, Immunofluorescence tests.
5. Microorganism for amino acids, baker's yeast, ethanol, aceton-butanol, citric acid, lactic acid. Also, antibiotics and vitamin producing organism.

BIOCHEMISTRY

1. Carbohydrates - Types of carbohydrates, Glycogenesis, glycogenolysis, & gluconeogenesis. Hexose monophosphate Shunt, associated diseases.
2. Proteins – Types, Denaturation, Biological activity, Renaturation, Urea formation, urea cycle, creatinine formation, Proteins as enzymes.
3. Lipids - Beta-Oxidation of fatty acids with energetics. Biosynthesis of cholesterol, bile acids /salts. Ketone bodies, associated diseases.
4. Vitamins - Biochemical role, Deficiency symptoms, Vitamins as co-factors in biochemical reactions.
5. Enzymes – Classification, Enzyme co-factors, Enzyme kinetics, Enzyme inhibition, competitive & non-competitive, & kinetics.
6. Nucleic acids - Purine & pyrimidine bases, DNA & RNA molecules, genetic information, Central dogma, Replication of DNA

✍ Important study points

- Proteins, carbohydrate, lipids, enzymes & genetics are very important. Cover it from Satyanarayanan
- Read only general and basic information like starting points of cycles and enzymes used, from Metabolism.
- Ramchandran plot
- Symbols for amino acids. Read biomolecules chapter from Morrison and Boyd

PHARMACEUTICAL MICROBIOLOGY

1. Microscopy and staining technique – Principle, working, Fluorescence & electron microscope, staining procedure
2. Bacteria - Fine structure, growth curve, Counting Methods, IMVIC test, Reproduction
3. Fungi and Viruses - Industrial and medical significance, HIV and Prions, types of Tumor viruses.
4. Microbial Assay - Importance, general methods of assay of antibiotics, methods for fungicidal & antiviral compounds, assay, microbial limit tests
5. Vaccines & Sera- Manufacturing, quality control, Preparation of allergenic extracts & diagnostics.

✍ Important study points

- **Staining, vaccines, understanding of HIV.**
- **Study reproduction in bacteria and virus.**
- **Influenza, and Cancer are important.**
- **Storage of vaccines should be studied.**
- **Disease and their causing agent**

PHARMACEUTICAL JURISPRUDENCE

1. The Pharmacy Act
2. Drugs and Cosmetics Act & Rules
3. Narcotic Drugs and Psychotropic Substances Act
4. Drugs and Magic Remedies
5. Medicinal and Toilet Preparations
6. Medical Termination of Pregnancy Act
7. Prevention of Cruelty to Animals Ac
8. Drug (Price Control) Order.
9. Intellectual Property Rights and Indian Patent Act
10. Prevention of Food Adulteration Act and Rules

✍ Important study points

- **All schedules,** whole of D&C Act, **various years, administrative**
- **Some knowledge of Intellectual Property Rights** (Patents, copyrights, trademarks, trade secrets, etc.)

PHARMACY PRACTICE

The best part for the preparation for this best reference for this would be Remington's Pharmaceutical Sciences. This branch is quite new here, so till dates students of branch used to do case study of prescriptions in Fortis hospital, PGI Chandigarh and govt. college chd. This is much like pharmacology and drug-drug interactions and different interactions are emphasized. Diabetes, heart diseases are main area of study.

PHARMACOINFORMATICS

Terminologies related with new emerging informatics e.g. proteomics, genomics, QSAR (2D, 3D, regression correlation).

✍ Important study points

- **Parametric/non-parametric test chi-square, t-test,** Wilcoxon signed-rank, goodness of fit.
- General: Mean, median, mode, standard deviation, correlation coefficient, variance, probability, precision, accuracy mean error, **relative error, profit and loss analysis**
- Regression: linear, **multiple regressions, correlation concept**
- Experimental design, factorial design, **Latin square design, crossover and parallel design.**
- **See about ANOVA.**

PHARMACEUTICAL MANAGEMENT

- ✓ **Organizational Behavior:** Ways in which people interact within organizations, including topics such as **motivation, leadership, communication, and team dynamics.**
- ✓ **Marketing Management:** Principles of marketing, including market research, product development, pricing, **promotion, and distribution.**
- ✓ **Financial Management:** Principles of finance and accounting, including financial analysis, budgeting, and **financial statement analysis.**

- ✓ **Operations Management:** Principles of operations management, including supply chain management, inventory **management, and production management.**
- ✓ **Strategic Management:** Strategy for an organization, including topics such as SWOT analysis, competitive **analysis, and strategy formulation.**
- ✓ **Human Resource Management:** Principles of managing people within organizations, including topics such as **recruitment, training, performance management,** and employee relations.
- ✓ **Project Management: Principles of managing projects,** including project planning, scheduling, **budgeting, and risk management.**

MISCELLANEOUS TOPICS (A STUDENT MUST REFER)

- **US FDA Approved Drugs**
- **Indian National Awards**
- **Founders of Big Companies**
- **Branded Products**
- **Important Software**
- **Pharma news**
- **Drug Interaction of Common Drugs**
- **General Knowledge, Logic & Aptitude**
- **Regulatory Authority of Different Countries**
- **Nobel Prizes**
- **Top Pharma Companies**
- **Brand Name**
- **Abbreviation and full forms**
- **Facts about Corona Virus**
- **New products from company**
- **Notable Epidemics And Pandemics**
- **Mental Ability & General Aptitude**
- **National Laboratories & Research Institutes**
- **Basic knowledge about NABARD, RBI, SBI, planning commission**

OTHERS (MOST IMPORTANT & SCORING)

Statistics, general mathematics and aptitude questions. Use MBA entrance test books like CET or CAT in MBA.

- Additionally some General awareness questions, synonym & antonyms - 5-10 questions
- Latest drugs banned & approved in US market, read latest journals, internet for this-5-6 questions
- Complete basics of organic chemistry.
- Advancement in analytical chemistry.

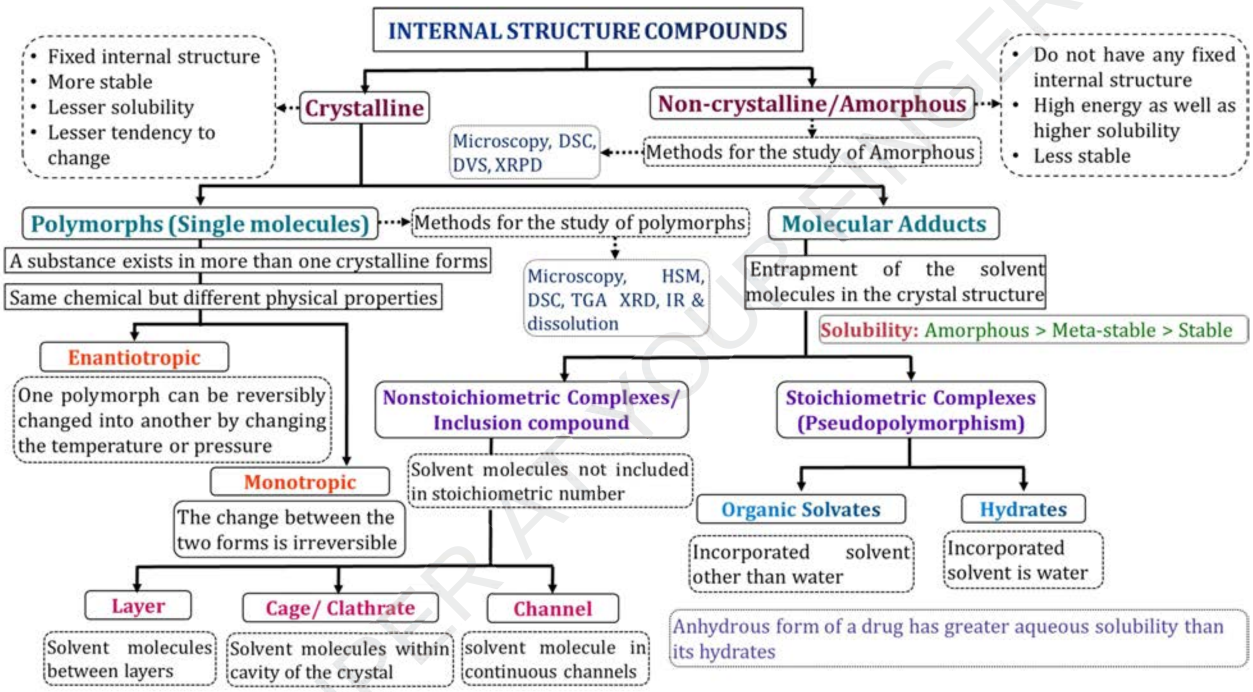
NIPER'S THRUST AREAS

- Microbial and viral diseases: Yeast, and fungi.
- Parasitic and tropical diseases: Malaria, Leishmaniasis, amoebiasis, cancer, aids etc.
- Metabolic Disorders: Diabetes Strokes
- Oxidizing, reducing agents & Stereochemistry
- Organic reactions & mechanisms
- Peptide and carbohydrate chemistry.
- Genomics and proteomics: yeast and fungi
- Hormonal disorders: Sex & TSH related diseases

Pharmaceutical Technology

Preformulation

- Analysis of **physicochemical** properties either of drug or with excipients to develop **safe and effective** dosage form.



❑ PRINCIPLE AREAS OF PREFORMULATION RESEARCH

SOLUBILITY STUDIES	• pKa Determinations • pH Solubility Profile and Common Ion Effects • Effect of Temperature • Solubilization • Partition Coefficient • Dissolution
BULK CHARACTERIZATION	• Crystallinity and Polymorphism • Hygroscopicity • Micromeritic Properties ✓ Particle Characterization ✓ Density and Porosity ✓ Powder Flow Properties
STABILITY ANALYSIS	• Solution Stability • Solid-state Stability • Drug-excipient Compatibility

❑ WETTING AGENTS

CONTACT ANGLE (COS θ)	DEGREE OF WETTING
θ = 0	Perfect wetting
0<θ<90°	High wettability
90° ≤ θ < 180°	Low wettability
θ = 180°	Perfectly non-wetting

❑ EQUATIONS

EQUATION	DETERMINATION
1. Noyes –Whitney equation - $\frac{dC}{dt} = \frac{DA}{hV}(C_s - C)$	Dissolution
2. Brunauer-Emmett-Teller (BET) (Adsorption method) $\frac{P}{V(p_0 - p)} = \frac{1}{V_m b} + \frac{(b-1)p}{V_m b p_0}$	Surface area
3. Poiseuille's equation Kozeny – Carman equation (Air Permeability method) $V = \frac{\pi \Delta p r^2 t}{8\eta L}$ $V = \frac{A}{\eta S^2} + \frac{\Delta P}{KL} \times \frac{\varepsilon^2}{(1-\varepsilon)^2}$	Surface area
4. Stokes Equation $V = \frac{2gr^2(d_1 - d_2)}{9\mu}$	Sedimentation
5. Higuchi $Q = \left[(D \in C_s/\tau)(2A - \in C_s)t\right]^{1/2}$	Release of drug from granular matrix
6. Arrhenius equation $k = Ae^{-Ea/RT}$	Stability of drug/product at Room Temperature at accelerated temperature

Monophasic Dosage Form

- Oral liquids are either homogeneous (solution) or heterogeneous (suspension and emulsions) liquid preparations, usually contains one or more active ingredients in a suitable liquid base.
- Liquid are dosage forms intended to be taken for internal as well as external use.
- They can be easily administered or applied and show rapid and efficient absorption and effects.
- Monophasic liquid dosage forms are represented by true solutions.

❑ SOLUBILITY

- Solubility of a given solute is defined as the "maximum concentration at which it can be dissolve in a particular solvent to yield the homogenous monophasic System".

Solution = Solute (Small proportion) + Solvent (large proportion)

<table>
<tr><td>Sorbitol /D-glucitol</td><td>Trade name- Neosorb.
Optical isomer of mannitol and used for diabetic products.
Sorbitol is hygroscopic at humidities above 65%.</td></tr>
<tr><td>Calcium salts</td><td>Non- hygroscopic and used with moisture sensitive drugs and not used with tetracycline due to complex formation.
Example: Calcium phosphate, calcium carbonate. Contain water for crystallization which do not release below 80°C.</td></tr>
<tr><td>Microcrystalline cellulose (MCC)
(Also act as disintegrating agents)</td><td>
<table>
<tr><th>Grades of MCC</th><th>Form</th></tr>
<tr><td>PH 101</td><td>Powder</td></tr>
<tr><td>PH 102</td><td>Granules</td></tr>
<tr><td>PH 301</td><td>Crystalline</td></tr>
<tr><td>PH 302</td><td>Amorphous</td></tr>
</table>
• Microcellac: 75% lactose and 25% MCC
• Ludipress: 93% α-lactose monohydrate + 3.5% PVP+ 3.5% cross-povidone
• Trade Name – Avicel → Microcrystalline Cellulose - directly compression material - Enhancing solubility.
</td></tr>
<tr><td colspan="2">CO-PROCESSED DILUENTS
Combination of two or more materials and to provide better tableting properties than a single substance</td></tr>
<tr><td>Ludipress</td><td>Lactose Monohydrate (93%), Kollidon 30 (3.5%), and Kollidon CL (3.5%)</td></tr>
<tr><td>Cellactose 80</td><td>α-Lactose monohydrate (75%) and cellulose powder (25%)</td></tr>
<tr><td>StarLac</td><td>α-Lactose monohydrate (85%) and maize starch (15%)</td></tr>
<tr><td>Pharmatose DCL14</td><td>Anhydrous P-lactose (95%) and lactitol (5%)</td></tr>
<tr><td>Avicel CE-15</td><td>MCC and guar gum</td></tr>
<tr><td>Vitacel VE-650</td><td>MCC (65%) and calcium carbonate (35%)</td></tr>
<tr><td>Di-Pac</td><td>Sucrose (97%) and dextrin (3%)</td></tr>
<tr><td>Cal-Tab®</td><td>Calcium sulfate 93% and vegetable gum 7%</td></tr>
<tr><td>Cal-Carb®</td><td>Calcium carbonate 95% and malto-dextrins 5%</td></tr>
<tr><td>Nu-Tab®</td><td>Sucrose 95–97%, invert sugar 3–4% & Magnesium stearate 0.5%</td></tr>
<tr><td>Sugartab®</td><td>Sucrose 90–93% and invert sugar 7–10%</td></tr>
<tr><td>Emdex®</td><td>Dextrose 93–99% and maltose 1–7%</td></tr>
<tr><td colspan="2">BINDER OR TABLET ADHESIVE OR GRANULATING AGENT -
Promote cohesive compacts. Also improve the free-flowing qualities</td></tr>
<tr><td>Natural gums</td><td>Concentration: 10 to 25 %
Examples: Acacia, tragacanth, alginic acid, Guar gum etc.</td></tr>
<tr><td>Starch paste</td><td>Concentration: 5-10 %</td></tr>
<tr><td>Sucrose</td><td>Concentration: 50-75 %</td></tr>
<tr><td>Gelatin</td><td>Concentration: 10-20 %</td></tr>
<tr><td>Polymers</td><td>• Hydroxy propyl cellulose - 2-6%
• Hydroxy propyl methylcellulose - 2-5%
• Ethylcellulose-0.2 to 0.5%
• PVP (polyvinyl pyrrolidone)-2%</td></tr>
<tr><td colspan="2">DISINTEGRANT
Facilitates tablet breakup or disintegration</td></tr>
<tr><td>Starch</td><td>Concentration: 5-20 %</td></tr>
<tr><td>Pregelatinized starch</td><td>Concentration: 5-15 %
Examples: Starch 1500</td></tr>
<tr><td>Carboxymethyl starches</td><td>Concentration: (1 - 8% & 4% as optimum)</td></tr>
</table>

❑ QUALITY CONTROL TEST OF TABLET

QUALITY CONTROL TESTS OF TABLET

Tablets Size & Shape

Micrometer
Vernier Calipers

Organoleptic Properties

Colour Uniformity and Instruments used for color evaluation - Reflectance spectrophotometry, colorimetric measurements, Micro-reflectance photometer

Content Uniformity (Official Test)

Total tablet taken for the test – **30.**
Total assayed – Atleast 10 by analytical technique.
Test passed if –

9 Tablets	Contain 85-115% content
10 tablets	Contain 75-125% content
If above condition not satisfied then other 20 tablets	No one should fall outside 85-115% range.

Weight Variation

% VARIATION	AVERAGE WEIGHT	
	IP	USP
±10%	85 mg or less	130 mg or less
±7.5%	80 mg to 250 mg	130 mg to 324 mg
±5%	>250 mg	>324 mg

Mechanical Strength

Friability (Official Test)

Instrument	Roche Friabilator
Tablets falls	6 inch / 15 cm
Speed	25 RPM
Total resolution	100
Time required	4 minutes
Internal diameter	283 to 291 mm
Depth	36 to 40 mm
% Acceptance	NMT 1% (IP) & NMT 0.5 - 1% (USP)

Hardness

- Monsanto Tester
- Pfizer Tester
- Strong-cobb Tester
- Erweka Tester
- Schleuniger Tester

Dissolution Test (Official Test)

Dissolution Apparatus

- **Type-I** Basket Type (USP) Paddle Type (IP)
- **Type-II** Paddle Type (USP) Basket Type (IP)
- **Type-III (USP & IP)** Reciprocating Cylinder
- **Type-IV (USP & IP)** Flow through Cell
- **Type-V (USP)** Paddle Over Disk
- **Type-VI (USP)** Rotating Cylinder
- **Type-VII (USP)** Reciprocating Disk

Disintegration

Glass tubes	6 Tubes (each 3 inches long)
Mesh screens	**USP** – 10 mesh (1.7 mm) **IP** – 8 mesh (2 mm)
Temperature	37°C ± 2°C
Tablets up and down from distance	5 – 6 cm
Frequency	28 to 32 cycles per minute

❑ TYPES OF USP DISSOLUTION APPARATUS AND THEIR APPLICATION

USP APPARATUS	DESCRIPTION	ROTATING SPEED	DOSAGE FORM
Type I	Basket Apparatus	50-120 rpm	Conventional tablet, chewable tablet, controlled release
Type II	Paddle Apparatus	25-50 rpm	Orally disintegrating tablet, chewable tablet, controlled release, suspension
Type III	Reciprocating Cylinder	6-35 rpm	Controlled release, chewable tablet
Type IV	Flow Through Cell	N/A	ER, poorly soluble API, Powder, granules, microparticles, implants
Type V	Paddle Over Disk	25-50 rpm	Transdermal
Type VI	Cylinder	NA	Transdermal
Type VII	Reciprocating Holder	30 rpm	Controlled Release Dosage Forms

❑ LIMITS OF DISINTEGRATION TEST IP AND USP

TYPES OF TABLET/CAPSULES	DISINTEGRATION MEDIA	DISINTEGRATION TIME (MIN)	
		IP	USP
Dispersible tablet	Water (24-26°C)	3 or less	3 or less
Effervescent tablet	Water (250 ml at 20-30°C)	5 or less	5 or less
Uncoated tablet	Water	15 or less	30 or less
Film coated tablet	Water or 0.1N HCl	30 or less	30 or less
Vaginal tablet	Water	30 or less	30 or less
Sugar coated tablet	Water	60 or less	60 or less
Enteric coated tablet	0.1 M HCl	120 or less	60 or less
	Phosphate buffer	60 or less	120 or less

❖ PLASTIC

TYPE OF PLASTIC PACKAGING MATERIAL	USES
Poly-propylene	Most widely used because of high melting point
Poly-ethylene	Ophthalmic products
Polystyrene	Plastic syringes
Flexible poly-vinyl chloride	Bags for I.V solution
Nylon & Silicon rubber	I.V catheters

❖ RUBBER

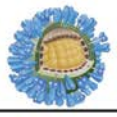
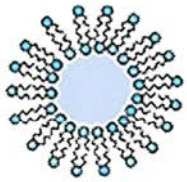
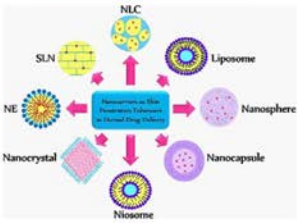
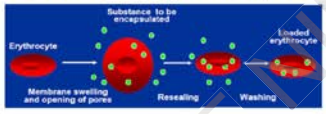
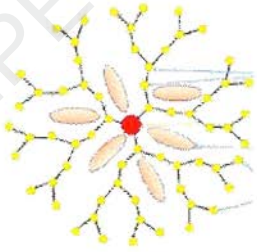
ADDITIVES	EXAMPLES
Elastomer	Natural rubber, Butyl rubber, Neoprene, Polypropylene
Vulcanizing	Sulfur peroxide
Accelerator	Guanithidine and sulfide 2 -mercaptobenzothiazole
Activator	Zinc oxide, Stearic acid
Filler	Carbon black, Clay
Antioxidant	BHA, BHT
Pigments	Zinc Chromate, Inorganic oxides
Plasticizers	Dibutyl phthalate, Stearic acid

❑ PHARMACOPEIAL STORAGE CONDITION FOR PARENTERAL PREPARATION

STORAGE CONDITION	TEMPERATURE
Cold storage or under refrigeration	Usually 2 to 8°C
Cool storage	Between 8 to 25 °C
Room temperature	Between 20 to 25 °C
Warm	Between 30 to 40 °C
Freezer	Store between -5 to -20 °C

❑ QUALITY CONTROL TEST FOR PARENTERAL PRODUCTS

Leaker test (Packaging integrity test)	• **Methylene Blue Test (for ampoules)** 1% Methylene blue dye and vacuum used. • **Hammer Test (for vials & bottles)** Presence of vacuum is detected by striking base of bottle sharply to produce water hammer sound.  Fig. Leaker test
Clarity test (Particulate matter test)	**Instrument used-** • **Light scattering (Nephelometer)** • **Light absorption, Electrical resistance (Coulter counter)** I.V. fluid meet the requirement- NMT 50 particle per ml of 10 µm and NMT 5 particle per ml of size 25 µm. (USP standard for large volume preparations)  Fig. Clearity test
Sterility test	Sterility testing is performed for detecting microorganism in parenteral product. Place parenteral product in culture media ✓ **Method** **1. Direct transfer method** (Thioglycolate culture media) • Is used for identification of aerobic and anaerobic bacteria. • Soybean casein Culture media - Used for identification of fungi. **2. Membrane filtration technique** • It is suitable for liquids, soluble powder with bacteriostatic or fungistatic oils, creams, and ointment. • It is done by passing the products from membrane filter with porosity of 0.45 µm, 47mm, 70 cm of mercury.

Virosomes 	Virosomes are spherical, unilamellar phospholipid bilayer vesicles incorporating virus derived proteins to allow the virosomes to fuse with the target cell.
Niosomes or non-ionic surfactant vesicles 	• Non-ionic surfactant vesicles, formed when non-ionic surfactants are added to cholesterol with subsequent hydration in aqueous media. • Addition of cholesterol provides rigidity to the bilayer leading to the formation of less permeable niosomes. **Methods of preparation** 1. Ether Injection (LUV) 2. Hand Shaking Method (MLV) 3. The "Bubble" Method 4. Reverse Phase Evaporation (LUV) 5. Multiple membrane extrusion method 6. Trans Membrane pH Gradient Drug Uptake Process (remote Loading) (MLV) 7. Microfluidization method (SUV) 8. Formation of niosomes from proniosomes
Carbon Nanotubes 	They are hollow cylinder made of carbon, atoms which can be filled and sealed for potential drug delivery
Nanoparticles 	• Nanoparticles are sub-nanosized colloidal structures composed of synthetic or semi-synthetic polymers. ✓ Size range: 10–1000 nm ✓ The drug is dissolved, entrapped, encapsulated or attached to a nanoparticle matrix. **Based on Method of Preparation:** • **Nanocapsules:** Nanocapsules are systems in which the drug is confined to a cavity surrounded by a unique polymer membrane. • **Nanospheres:** Nanospheres are matrix systems in which the drug is physically and uniformly dispersed.
Resealed erythrocytes 	• When erythrocytes are suspended in a hypotonic medium, they swell to about one and a half times their normal size, and the membrane rupture in the formation of pores with diameters of 200 to 500 A°. • The pores allow equilibration of the intracellular and extracellular solution. • If the ionic strength of the medium then is adjusted to isotonic and the cells are incubated at 37°C, the pores will close and cause the erythrocyte to "Resealed".
Dendrimers 	• The term "Dendrimer" (Greek: dendron means tree and meros is part) defined as class of chemical molecules which are highly branched with three-dimensional macromolecular architecture that is highly controlled and defined, with all bonds emanating from a central core. • These are characterized by a combination of a high number of functional groups and a compact molecular structure. • several types of dendrimers include those which have immense applications in drug delivery including Poly(amidoamine) (PAMAM) dendrimers, Poly(propylene imine) (PPI) dendrimers, polyether-copolyester (PEPE) dendrimers, PEGylated dendrimers, peptide dendrimers, etc.

Physical Pharmacy

States of Matter

❑ TYPES OF ATTRACTIVE INTERMOLECULAR FORCES

1. Vander Waals Forces	• It is weak forces that involve the dispersion of charge across a molecule called a dipole. • Vander Waal's equation explains the behaviour of Real gases. .	
Types	**Keesom forces**	• The permanent dipoles interact with one another in an ion like fashion. • Large groups of molecules may be associated through weak attractions known as dipole–dipole or Keesom forces. • Keesom forces, also known as permanent dipole-permanent dipole forces, are a type of Van der Waals interaction that occurs when two permanent dipoles attract each other. • Keesom interactions has a force of 1-7 kcal/mol.
	Debye force	Permanent dipoles are capable of inducing an electric dipole in nonpolar molecules to produce dipole-induced dipole, or Debye, interactions.
	London attraction/forces	Nonpolar molecules can induce polarity in one another by induced dipole-induced dipole, or London, attractions.
2. Orbital Overlap	• Dipole–dipole force is the interaction between pi-electron orbitals in systems. • **e.g.-** Aromatic– aromatic interactions.	
3. Ion-Induced Dipole Forces	• Attractions occur between polar or nonpolar molecules and ions. • **e.g.-** Attracts the relatively negative oxygen atom of water and the anion attracts the hydrogen atoms of the dipolar water molecules.	
4. Ion–Ion Interactions	• Electrovalent bond between two counter ions is the strongest bonding interaction and can persist over the longest distance. • Ion–ion interactions may be intermolecular (e.g. - a hydrochloride salt of a drug) or intramolecular (e.g. - a salt bridge interaction between counter ions in proteins).	
5. Hydrogen Bonds	The interaction between a molecule containing a hydrogen atom and a strongly electronegative atom such as fluorine, oxygen or nitrogen.	

❑ GAS LAW

S.NO.	NAME OF LAW	EQUATION USED	COMMENTS
1	**Gay – Lussac law**	$\frac{P_1}{T_1} = \frac{P_2}{T_2}$	Volume Constant
2	**Boyle's law**	$P_1V_1 = P_2V_2$	Temperature Constant

Examples → Flocculated particles in concentrated suspension/ Suspension of ZnO in mineral oil, certain paints, ointments	Examples → Liquid dispersions of natural and synthetic gums (tragacanth, sodium alginate, methyl cellulose, and sodium carboxy methyl cellulose). Jellies, liquid paraffin.	Examples→ Suspension of corn starch in water; Suspension containing high concentration of solids; Inorganic pigments in water; kaolin in water; zinc oxide in water.

❖ Time dependent

THIXOTROPY	NEGATIVE/ ANTITHIXOTROPY
GEL-SOL-GEL system.	• SOL-GEL-SOL system • Also called rheopexy
Shear thinning system.	• Shear thickening system • Viscosity increases so, downward curve more towards right.
Time Dependent behavior	
• It is the decrease in viscosity as a function of time upon shearing, then recovery of original viscosity as a function of time without shearing.	
e.g. – Procaine penicillin G (40-70% w/v in water)	**e.g. –** Low solid content (1-10%) flocculating system; magnesia magma at equilibrium it forms solution.

❑ CONCEPT OF VISCOSITY

Viscosity	• **Flow property** of a simple liquid is expressed in terms of viscosity. • Viscosity is calculated by :- $\boldsymbol{\eta = \frac{F}{G}}$
Coefficient viscosity	• The force **per unit area required** to maintain unit difference in velocity between two parallel layers in the liquid, one meter apart. • In CGS unit viscosity is expressed as poise. • It is also expressed as **dyne/cm².** • SI system units = Pascal second • 1 Pa.s = 1N.s/m^2 , 1 Poise = 1kg/m.s • 100 centipoise = 1 Poise, 1000 millipoise = 1 Poise • 1 mN.s/m^2 = 1 centipoise
Fluidity	Fluidity, **Ø** is used to denote the reciprocal of viscosity. Fluidity, $\boldsymbol{\emptyset = \frac{1}{\eta}}$
Kinematic viscosity	• It is defined as the **absolute viscosity** divided by the density of the liquid at **a specific temperature**: $\boldsymbol{\text{Kinematic viscosity} = \frac{\eta}{\rho}}$ • The unit of kinematic **viscosity is stokes** and centistokes • It is expressed as m^2/s. • 1 Stoke (S) = 10^{-4} m^2/s, 1 Centistoke = 10^{-6} m^2/s • 1 Poise/(kg/m^3) = 1 centistoke

Relative viscosity	The coefficient, abbreviated, η_r, is defined as the **ratio of viscosity** of the dispersion (η) to that of the solvent, η_0, $$\eta_r = \frac{\eta}{\eta_0}$$
Specific viscosity	The relative **increase in the viscosity** of the dispersion over that of the solvent alone. $$\eta_{sp} = \frac{\eta - \eta_0}{\eta_0}$$
Reduced viscosity	The ratio of specific viscosity to the concentration. $$\eta_{red} = \frac{\eta_{sp}}{c}$$
Intrinsic viscosity	• The reduced viscosity is determined at various concentration of a substance and the results are plotted. • The resulting line can be extrapolated to c = 0 to obtain the intercept. • The intercept value is known as intrinsic viscosity.
Plastic viscosity	• The plastic viscosity is estimated using equation $$f = C_f \times T_f$$ T_f = Torque at the shearing stress axis C_f = Instrumental constant

❑ TYPES OF VISCOMETERS

VISCOMETER	NAME	USES
Capillary viscometer	• Ostwald viscometer, • Suspended level viscometer	Liquid paraffin, dextran 40 injection, methyl cellulose solution
Falling sphere viscometer	Hoeppler viscometer	This instrument can be used over the range 0.5 to 200,000 poise
Rotational viscometer	Cup and bob	• **Couette type** – Revolving cup type - MacMichael viscometer • **Searle type**: Revolving bob type – Stormer viscometer
Cone and plate	Ferranti–Shirley viscometer	Rheological evaluation of some pharmaceutical semisolids.
Brookefield viscometer (T-spindle)	Rotational viscometer	Suspension, emulsion, cream, lotions

Suspension

❑ DIFFERENT BETWEEN FLOCCULATED AND DEFLOCCULATED SUSPENSION

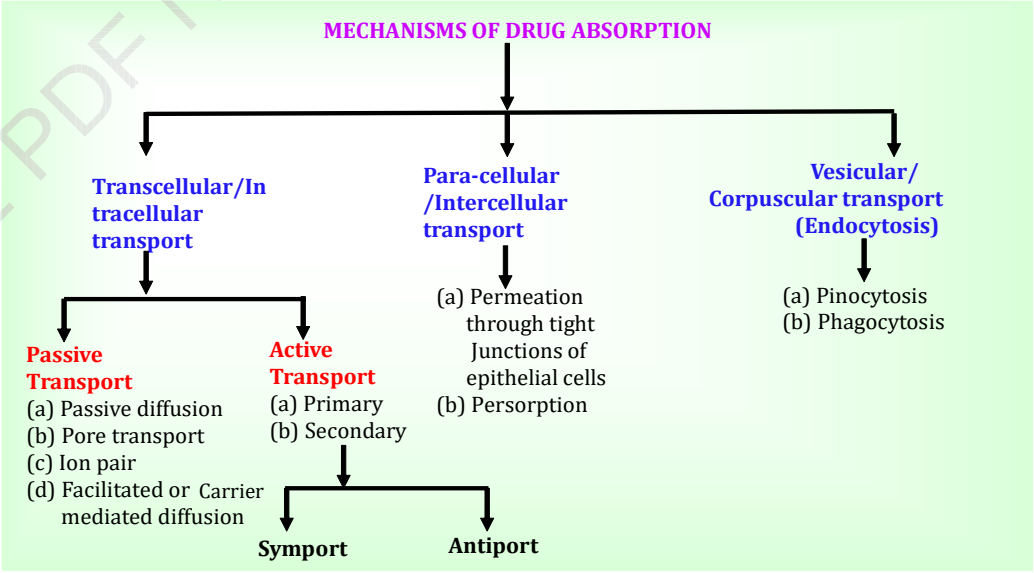
FLOCCULATED SUSPENSION	DEFLOCCULATED SUSPENSION
Clear supernatant	Cloudy supernatant
Particles experience attractive forces	Particles experience repulsive forces
Particles form loose aggregates	Particles exist as separate entities
Rate of sedimentation is high	Rate of sedimentation is slow

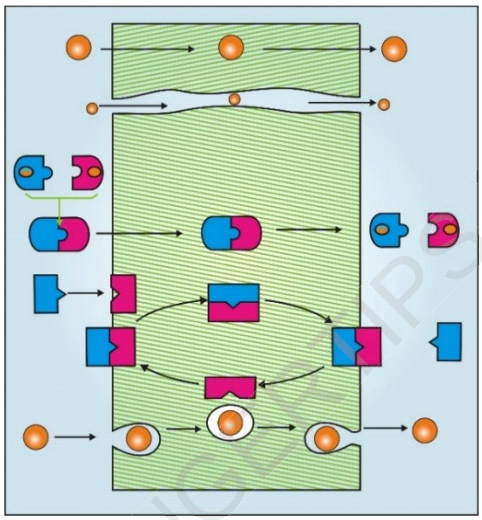
Biopharmaceutics

❑ IMPORTANT TERMS AND THEIR DEFINITION

IMPORTANT TERMS	DEFINITION
Biopharmaceutics	**Biopharmaceutics** is defined as the **study of factors influencing** the **rate and amount of drug** that **reaches the systemic circulation** and the use of this information to optimise the **therapeutic efficacy of drug products.**
Bioavailability	**Bioavailability** is defined as **Rate and extent (amount) of drug absorption.**
Pharmacokinetic	Pharmacokinetic is a study of **what the body does to the drug.** **ADME (Absorption, Distribution, Metabolism, Excretion)**
Absorption	The **process of movement of drug** from its site of administration to the **Systemic circulation.**
Distribution	Movement or reversible transfer of drug between one compartment to another **(Blood and the Extravascular tissue).**
Biotransformation	Usually **inactivates the drug.** Also known as **Metabolism.**
Elimination	Process that tends to **remove the drug from the body** and terminates its action.
Excretion	Responsible for exit of drug/metabolites from the body.
Pharmacodynamics	**Pharmacodynamics** is a study of **what the drug does to the body.** It related **response to Concentration of drug in the body.**
Dosage regimen	**Dosage regimen** is the manner in which the drug should be taken. The schedule of dosing (e.g., four times a day for 10 days) is referred to as the **dosage regimen.**
Clearance	• **Clearance** is defined as the **hypothetical volume of body fluids** containing drug from which the drug is removed or cleared completely in a specific period of time. • It is expressed in **ml/min.**

❑ MECHANISMS OF DRUG ABSORPTION



ABSORPTION MECHANISM	DRUGS ABSORBED	GI LUMEN	MEMBRANE	BLOOD
Passive Diffusion	Most drugs having high lipophilicity and MW in the range 100-400			
Pore Transport	Water-soluble drugs of MW less than 100			
Ion-Pair Transport	Drugs that ionize at all pH conditions absorbed after complexing with oppositely charged ions			
Carrier-Mediated Transport	Structure – specific drugs with affinity for carriers transported from specific sites			
Endocytosis	Macromolecular nutrients and drugs as solid particles or oily droplets			

❑ FACTORS INFLUENCING GI ABSORPTION OF A DRUG

Factors influencing GI absorption of a drug

Pharmaceutical factors

Physiochemical properties of drug substances

1. Drug solubility and dissolution rate
2. Particle size and effective surface area
3. Polymorphism and amorphism
4. Pseudopolymorphism (hydrates/solvates)
5. Salt form of the drug.
6. Lipophilicity of the drug
7. pKa of the drug and gastrointestinal pH
8. Drug stability
9. Stereochemical nature of the drug

Dosage form characteristics and pharmaceutical ingredients

1. Disintegration time (tablets/capsules)
2. Dissolution time
3. Manufacturing variables
4. Pharmaceutical ingredients (excipients/adjuvants)
5. Nature and type of dosage form
   Solution>Emulsion>Suspension>Capsules>Tablet>Coated Tablets>Enteric coated tablets>sustained release product
6. Product age and storage conditions

Patient related factors

1. Age
2. Gastric emptying time
3. Intestinal transit time
4. Gastrointestinal pH
5. Disease states
6. Blood flow through the GIT
7. Gastrointestinal contents:
   (a) Other drugs
   (b) Food
   (c) Fluids
   (d) Other normal GI contents
8. Contact time with gastrointestinal mucosa
9. Presystemic metabolism by:
(a) Luminal enzymes
(b) Gut wall enzymes
(c) Bacterial enzymes
(d) Hepatic enzymes

❑ BIOPHARMACEUTICS CLASSIFICATION SYSTEM FOR DRUGS

CLASS	SOLUBILITY	PERMEABILITY	ABSORPTION PATTERN	RATE LIMITING STEP IN ABSORPTION	EXAMPLES
I	**High**	**High**	Well absorbed	**Gastric emptying**	Diltiazem, Metoprolol, Propranolol
II	**Low**	**High**	Variable	**Dissolution**	Nifedipine, Ketoprofen, Carbamazepine **Beta-cyclodextrin**

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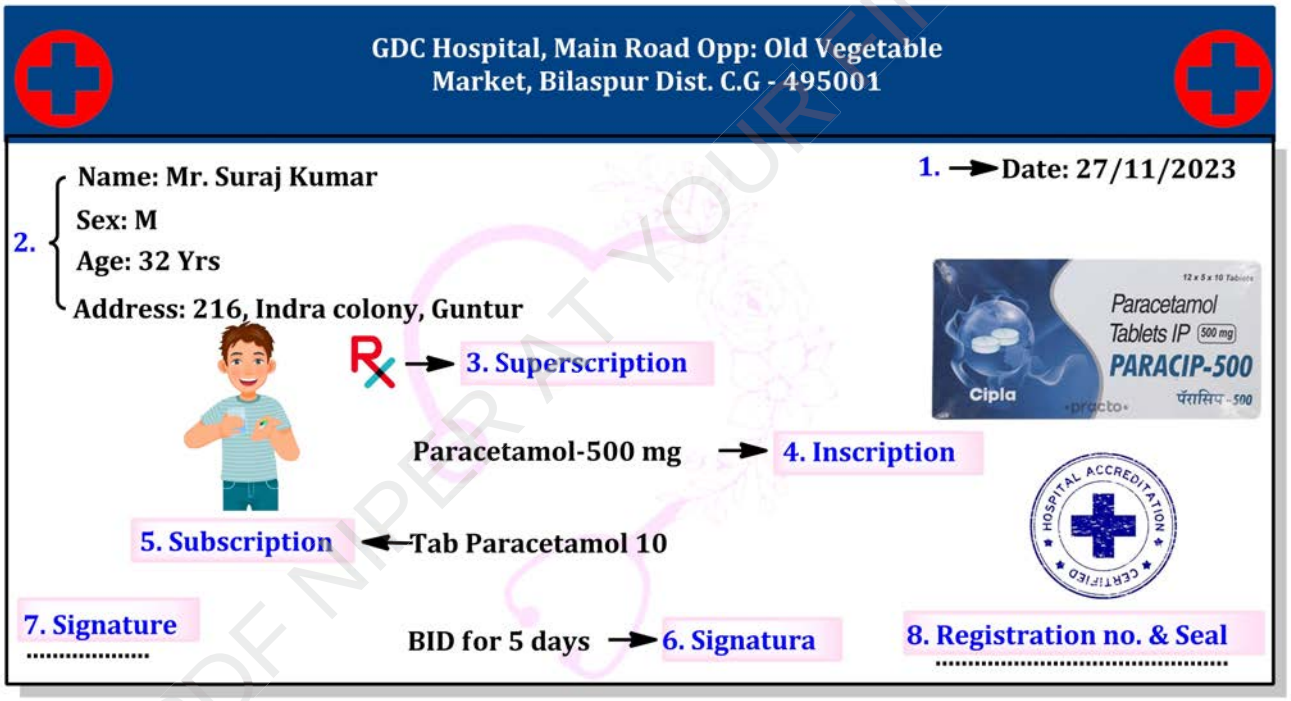
Dispensing and Hospital Pharmacy

Prescription

Prescription: A written order by a licensed professional for a pharmacist to prepare and dispense a specific medication for a patient.

Physician/Doctor/Dentist/Veterinarian —Prescription→ **Pharmacist** —Medicine→ **Patient**

❑ FORMAT OF PRESCRIPTION



❑ PARTS OF PRESCRIPTION

1. **Date:** Helps to find out the date of prescribing and date of presentation for filling the prescription.
2. **Name, age, sex and address of patient:** Serves to identify the prescription. In case of children, helps to check the prescribed dose of medication.
3. **Superscription:** Written before writing the prescription. Represented by **(R_x).**

(Latin word → You take 'Take thou')

Earlier → Sign of Jupiter, God of healing

4. **Inscription:** Contains the names and quantities of the prescribed ingredients.
5. **Subscription:** Direction to the pharmacist for preparing the prescription and number of doses to be dispensed.
6. **Signatura:** Direction to be given to the patient regarding the administration of the drug.

ON THE BASIS OF SURFACE AREA		
Catzel's formula/ Body surface area formula	$\text{Child dose} = \left[\frac{\text{Body surface area of child } (m^2)}{\text{Body surface area of adult } (1.73)}\right] \times \text{Adult dose}$	**QUE:** Calculate a dose for a child of 6 years old whose surface area is 1.5 m^2 when adult dose is 100 mg. **SOL:** Surface area: 1.5, Adult dose: 100 mg $\frac{1.5}{1.73} \times 100 = \mathbf{86.7\ mg}$

ON THE BASIS OF CHILD DOSE WITH RESPECT OF ADULT DOSE

Gaubin's formula

AGE UNDER (YEARS)	PARTS OF ADULT DOSE
Under 1	1/12
1-2	1/8
2-3	1/6
3-4	1/4
4-7	1/3
7-14	1/2
14-20	2/3
21-60	Full adult dose
60-70	4/5
70-80	3/4
Over 90	1/2

QUE: Calculate the dose for 15 years old child, if adult dose is 650 mg.

SOL: Age of child: 15, Adult dose: 650 mg

$\frac{2}{3} \times 650 = \mathbf{433.3\ mg}$

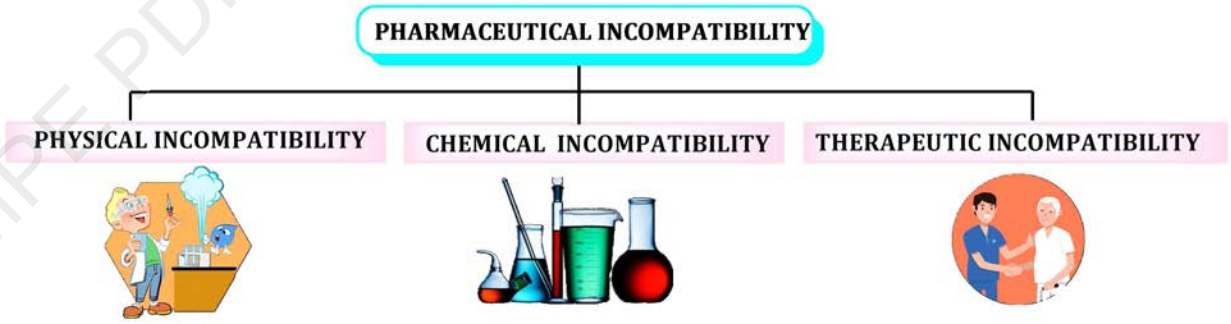
Incompatibilities

- A change resulting from mixing of two or more than two antagonistic substance is incompatibility.

Incompatibility occurs during

Compounding | Dispensing | Formulation | Manufacturing | Packaging | Administration of drugs

❖ Types of incompatibilities



(B) Chemical Incompatibility:

Chemical interactions occurs between the ingredients of prescription

⇩

Toxic or inactive product is formed

⇩

Due to oxidation reduction, acid base hydrolysis or combination reaction

✓ **Examples of chemical incompatibilities and their methods of correction**

1. Alkaloidal Incompatibility:

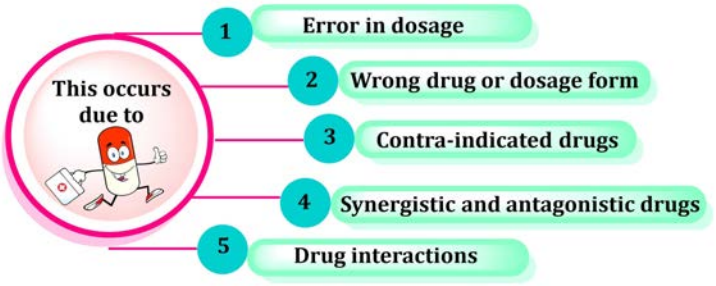
EXAMPLES	METHOD OF CORRECTIONS
Alkaloidal salts with alkaline substances	
R_x Strychnine hydrochloride solution: **6 ml** Aromatic spirit of ammonia: **4 ml** Water upto: **120 ml**	Strychnine hydrochloride (alkaloidal salt) + Aromatic spirit of ammonia (alkaline substance) ↓ Quantity is more than its solubility in water ↓ Negligible amount of alcohol which cannot dissolve strychnine → Diffusible precipitate
Alkaloidal salts with salicylates	
R_x Quinine hydrochloride: **0.12 g** Sodium salicylate: **4.0 g** Water upto: **100 ml**	Quinine hydrochloride + Sodium salicylate → Quinine salicylate Separated ↓ Indiffusible precipitates
Alkaloidal salts with soluble iodides and bromides	
R_x Potassium iodide: **1.5 g** Tincture of stramonium: **8.5 g** Chloroform water to make: **100 ml**	Tincture stramonium (Solanaceous alkaloid) Forms → Diffusible precipitate of hydro-iodides + Potassium iodide

2. Soluble salicylates Incompatibility:

EXAMPLES	METHOD OF CORRECTIONS
Soluble salicylates with ferric salt	
R_x Ferric chloride solution: **2 ml** sodium salicylate: **3.0 g** Water upto: **90 ml**	Ferric chloride + Sodium salicylate → Ferric salicylate → Separated as indiffusible precipitates Sodium bicarbonate ↓ ppt remain soluble ↓ Clear mixture formed

(C) Therapeutic Incompatibility:

- Result of prescribing certain drugs to a patient with the intention to produce a specific degree of pharmacological action, but the nature or intensity of the action produced is different from that intended by the prescriber.
- This occurs due to the following reasons:



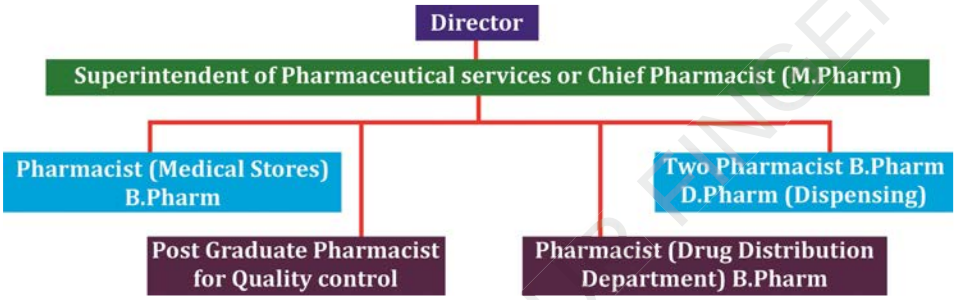
1. **Error in dosage form:** Over dosing or under dosing in dispensing medication are the most serious forms leading to therapeutic incompatibility.

Medium hospitals	**Beds between 500-1000**	Budget Hospital
Small hospitals	**Beds between 100-500**	Private Hospital
		Teaching hospital

❖ Number of Pharmacist required

HOSPITAL BED STRENGTH	PHARMACIST REQUIRED
Up to 50 beds	3
Up to 100 beds	5
Up to 200 beds	8
Up to 300 beds	10
Up to 500 beds	15

❖ Requirement of a Hospital Pharmacist



- **Pharmacist** is a **link between** the **medical professionals and public**
- **Drug required to be hospitals** by purchased for **medical superintendent**
- Minimum **500 hours training** is for a **pharmacy registration**

❖ Floor space requirement

AREA IN SQ. FT. FOR	50 BEDS	100 BEDS	200 BEDS
Compounding and dispensing area	205	350	495
Parenteral solution laboratory		185	200
Store room		125	200
Manufacturing laboratory			120
Office and library			105
Circulation			60
Total	**205**	**630**	**1,180**

- As per drug and **cosmetics act**, **schedule M**, a minimum **250 sq feet area** is essential for a **Hospital pharmacy**.
- It increased **10 sq. m. per bed** for **100 beds**, **6sq. m. per bed** for **200 beds** and **5 sq. m.** for more than **200 beds** Hospital.
- **Minimum space** required for **manufacturing ASU drug** is **1200 sq. ft.**

TERMINOLOGY	DESCRIPTION
Drug overdose	A drug overdose is **taking too much** of a **substance,** whether it's prescription, **over-the-counter, legal, or illegal.**
Drug abuse	It refers to use of a drug by **self-medication in a manner** and **amount that deviates** from the **approved medical and social patterns** in a **given culture** at a **given time.**
Polypharmacy	The use of **multiple medications** in a patient, commonly an older adult. **Polypharmacy** is being on **five or more drugs** at the same time on a regular therapeutic basis.

Cosmetic Technology

COSMETICS PREPARATIONS

- **External preparations** and/or mean to be applied skin, hair, nails etc
- **The term cosmetic, arises from the Greek word "Kosmeticos" which means to adorn**
- Used for **beautification and improvement** of appearance
- Cosmetics include such **cleansing agents such as shaving creams, shampoos, cleansing creams and lotion** but **not include toilet and bath soaps**

Purposes: **coloring, cleaning, softening, setting, nursing, preservation, protecting, removal, waving & mollification (to be soften)**

- **Preparation for Skin**
- **Preparation for Hair**
- **Preparation for Nails**
- **Preparation for hygienic purpose**

CLASSIFICATION OF COSMETICS

Skin

- **Powders compacts**
  - Face & Compacts powders
  - Body powders
  - Prickly heat powders
  - Face pack
- **Creams**
  - Vanishing creams
  - Cold creams
  - All purpose creams
  - Night cream
  - Moisturing creams
  - Foundation creams
  - Massage cream
  - Hand body cream
- **Lotions**
  - Skin lotions
  - Astringent lotions
  - Cleansing lotion
- **Colourants**
  - Lipsticks
  - Rouges
- **Perfumes**
  - Antiperspirants
  - Deodorants

Hair

- **Hair remover**
  - Depilatories
  - Epilatories
  - Shaving prep.
- **Hair wave prep.**
  - Hair dressing
  - Hair conditioner
- **Shampoos**
  - Dyes
  - Hair lotions
  - Dandruff lotions
- **Eye lash prep.**
  - Mascaras
  - Eye brow pencils
  - Kohls

Nail

- Lacquers
- Laquer removers
- Nail polishes
- Cuticle removers

Hygienic

- **Dental**
  - Powders
  - Pastes dentrifices
  - Lotions
  - Mouth washes
- **Bath**
  - Soap, Bath salts

Pharmaceutical Engineering

❑ MECHANISM OF HEAT FLOW

Conduction	• It is a process in which heat flow in a body is achieved by the transfer of the momentum of individual atoms or molecules without mixing. • Conduction is a mode of heat transfer that occurs when heat energy is transferred between molecules through direct contact
Convection	• It is a process in which heat flow is achieved by actual mixing of warmer portion with cooler portions of the same material. • Water heating primarily occurs through convection, which involves the transfer of heat through the movement of fluids.
Radiation	• Radiation is an energy transfer process in which heat is transferred through space by means of electromagnetic waves. • Radiation does not require a medium for heat transfer.

❑ REYNOLDS NUMBER

REYNOLDS NUMBER- It is used for measurement and types of flow determination. It is widely used to classify flow behavior of fluids is the ratio of inertial forces to viscous forces.

Reynold's number,

$$R_e = \frac{Du\rho}{\eta}$$

D = Diameter of pipe, m **u** = Average velocity, m/s

ρ = Density of liquid, kg/m^3 η = Viscosity of the fluid, Pa.

- When R_e < 2100 then flow is laminar or viscous or streamline.
- R_e > 4000 then flow is turbulent.
- R_e is 2100 – 4000 then flow is laminar or turbulent changes from laminar to turbulent.
- A large Reynold number is indication of highly turbulent flow.

❑ HYDRODYNAMIC METHOD

HYDRODYNAMIC METHOD	USES
Orifice meter (Variable head meter)	• It measures the variation in the pressures across a fixed constriction placed in the path of flow consisting of a constant area. • Used for testing purpose like for steam lines.
Venturi meter (Variable head meter)	• Venturi meter is referred to as variable head meter, i.e., it measures the variable differential pressure across a fixed constriction placed in the path of flow. • It is used for liquids, especially water. • It is used in on-line installation and for measurement of gases.
Pitot tube (Insertion meter)	• It is used to measure the velocity head of the flow. • Pitot tube measures the velocity at one point only.

Pharmaceutical Jurisprudence

Years of Different Acts

ACTS	PASSED	RULES	CAME IN FORCE	AMMENDMENTS/ REPLACEMENTS
Pharmacy Act	1948	--	4th March 1948	1976(Major), 1959, 1981
AICTE Act	1987	--	28th March 1988	--
Drugs & Cosmetics Act	1940	1945	--	1972,1982 (Major), 2008 2016
Narcotic Drugs and Psychotropic Substances Act	1985	--	14th November 1985	--
Dangerous Drug Act	1930	1957	--	--
Opium Act	1878	--	--	1857, 1858
Medicinal and Toilet Preparations (Excise Duties) Act	1955	1956	1st April 1957	--
Drugs and Magic Remedies (Objectionable Advertisements) Act	1954	1955	1st April 1955	1963
Drugs (Prices Control) Order	2013	--	15th May 2013	1966, 1970, 1979, 1987, 1995, 2005
Essential Commodities Act	1955	--	1st April, 1955	
Poisons Act	3rd Sept. 1919	--	--	1904
Medical Termination of Pregnancy Act	1971	1975	10th August, 1971	--
Prevention of Food Adulteration Act	1954	1955	29th September, 1954	1964, 1976, 1986
Prevention of Cruelty to Animals Act	1960	--	26th December, 1960	1890
Patents Act	1970	2003	Act- 20th April 1972 Rules- 20th May 2013	March 1999, June 2002, 2005
Designs Act	2000	2001	11th May 2001	Acts - 1911 Rules - 1933
Copyright Act	1957	--	21st January1958	1983, 1984, 1992, 1994, 1999, 2012
Trade Marks Act	1999	2002	15th September 2003	1958
Shops and Establishments Act	1939	1948	11th January 1949	--
Insecticides Act	1968	1971	30th October 1971	--

Pune	• Indian Society of Blood Transfusion & Immunology • National Institute of Virology • National AIDS Research Institute
Mumbai	Enterovirus Research Centre, Haffkine Institute compound
Thane	Central Drugs Testing Laboratory (Intra-Uterine Devices and Falope)
New Delhi	• National Institute of Communicable Diseases (NICD) (For Polio Vaccine) • Indian Council of Medical Research • Central Health Education Bureau
Jaipur	National Ayurvedic Institute
Geneva (Headquarter)	World Health Organization
Kolkata (Headquarter)	Patent Office
Nagpur	Patent Information Centre
Noida	National Institute of Biologicals
Coonoor	Pasteur Institute of India (Oral Poliomyelitis)
Bangalore	National Centre for Biological Sciences (NCBS) National Institute of Unani Medicines
Jaipur	National Institute of Ayurveda

Drug Regulatory Agencies of Different Countries

COUNTRY	NAME OF REGULATORY AUTHORITY
USA	United States Food and Drug Administration (USFDA)
UK	Medicines and Healthcare Products Regulatory Agency (MHRA)
Australia	Therapeutic Goods Administration (TGA)
India	Central Drug Standard Control Organization (CDSCO)
Canada	Health Canada (HC)
Europe	European Medicine Agency (EMA)
Brazil	Agencia Nacional de Vigilancia Sanitaria (ANVISA)/ Brazilian Health Regulatory Agency
Japan	Pharmaceutical and Medical Devices Agency (PMDA) [PMDA operates under the Ministry of Health, Labour, and Welfare (MHLW)]
Ireland	Health Products Regulatory Authority (HPRA)
Italy	Italian Medicines Agency
Austria	Austrian Agency for Health and Food Safety
Belgium	Federal Agency for Medicines and Health Products (FAMHP)
Germany	Federal Institute for Drugs and Medical Devices
Malaysia	National Pharmaceutical Regulatory Agency (NPRA)
Ukraine	Ministry of Health of Ukraine
Switzerland	Swiss agency for therapeutic product (SWISSMEDIC)
Singapore	Health Sciences Authority (HSA)
New Zealand	New Zealand Medicines and Medical Devices Safety Authority (MEDSAFE)
European Union	European directorate for the quality of medicines (EDQM)
Pakistan	Drug Regulatory Authority of Pakistan (DRAP)

REPACKING LICENSE	Drugs other than those specified in schedule C and C1	**24-B**	**25-B**
SALE OF DRUGS			
(A) WHOLE SALE	(i)Homoeopathic Drugs	**19B**	**20D**
	(ii) Drugs other than those specified in schedule C, C1 and X	**19**	**20B**
	(iii) Drugs other than those specified in schedule C, C1 from a motor vehicle	**19AA**	**20BB**
	(iv) Drug specified in schedule X	**19C**	**20G**
	(v) Drugs specified in schedule C and C1 but not included in schedule X	**19**	**21B**
	(vi) Drugs specified in schedule C and C1 from a motor vehicle	**19AA**	**21BB**
(B) RETAIL SALE	(i) Homeopathic drugs	**19B**	**20C**
	(ii) Drugs other than those specified in schedule C, C1 and X	**19**	**20**
	(iii) Drugs specified in C and C1 excluding X.	**19**	**21**
	(iv) Drugs specified in schedule X	**19C**	**20F**
(C) RESTRICTED	(i) Drugs other than those specified in schedule C, C1 & X	**----**	**20A**
	(ii) Drug specified in C, C1 but not in schedule X	**----**	**21 A**

Narcotic Drugs and Psychotropic Substances Act And Rules

Narcotic Drugs and Psychotropic Substance Act and Rules	1985
Act came in force	14th November 1985
Opium Act	1857, 1878
Dangerous Drugs Act	1930
Dangerous Drugs Rules	1957

IMPORTANT POINTS

- Central govt. shall appoint "Narcotic Commissioner" have powers and perform all functions relating to the cultivation of the opium poppy and production of opium.
- Central govt. constituent narcotic drugs and psychotropic substance consultative committee (NMT 20 members)
- Govt. opium factory – Gazipur (UP), Neemuch (MP)
- District opium officer – appoint one of the cultivators of opium poppy as Lambardar in each village where opium poppy is cultivated.
- Coca, Opium and Hemp comes under Dangerous Drugs Act.

DEFINITION

Medicinal cannabis	Medicinal hemp, means any extract or tincture of cannabis (hemp)
Narcotic drugs	Coca leaf, Cannabis (hemp), Opium, Poppy straw & included all manufactured drugs

International Organization For Standardization (ISO)

❑ INTRODUCTION

- It is an **Independent, Non-governmental organization,** whose membership consists of different
  National Standards Bodies.
- ISO was founded on **23 February 1947.**
- It is headquartered in **Geneva, Switzerland**.

❑ STANDARDS IN THE 9000 FAMILY INCLUDE

ISO 9000	Quality Management and Quality Assurance Standards Guidelines for Selection and Use.
ISO 9001	Quality Systems- Model for Quality Assurance in Design, Development, Production, Installation, and Servicing.
ISO 9002	Quality Systems- Model for Quality Assurance in Production, Installation, & Servicing.
ISO 9003	Quality Systems- Model for Quality Assurance in Final Inspection and Test.
ISO 9004	Guidelines for the applications of standards in quality management and quality systems.

❑ POPULAR STANDARD OF ISO

ISO 9001	Quality management
ISO 14001	Environmental management
ISO 45001	Occupational health and safety
ISO 3166	Country codes
ISO 13485	Medical devices
ISO 26000	Social responsibility
ISO 50001	Energy management
ISO 31000	Risk management
ISO 22000	Food safety management
ISO 27001	Information security management
ISO 20121	Sustainable events
ISO 37001	Anti-bribery management systems

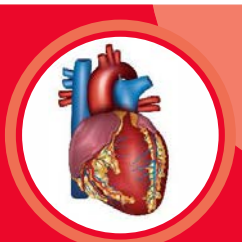
Code of Federal Regulations (CFR)

- In the law of the United States, the Code of Federal Regulations (CFR) is the codification of the general and permanent regulations.
- It is promulgated by the executive departments and agencies of the federal government of the United States.
- The CFR is divided into 50 titles that represent broad areas subject to federal regulation.

21 CFR
21 – Title Number
C – Code
Of
F – Federal
R - Regulation

❑ CODE OF FEDERAL REGULATION (CFR) TITLE 21

PARTS	FEATURES
21 CFR part 11	Electronic submission and electronic signature
21 CFR Part 16	Regulatory Hearing Before the Food and Drug Administration



Pharmacology

General Pharmacological Principles

INTRODUCTION OF PHARMACOLOGY

- **Pharmacology -** Branch of science that concerned with **study of drug and its action** in the body.
- **Drug -** It is a substance that is used or intended to be used to modify or explore physiological system or pathological states, for benefit of the recipient.

❑ HISTORICAL ASPECT OF PHARMACOLOGY

DISCOVERIES	SCIENTIST
Father of Pharmacology	Oswald Schmiedeberg
Father of Indian Pharmacology	Ram Nath Chopra
Father of Indian Pharmacy Education	Mahadeva Lal Schroff
Father of Chemotherapy	Paul Ehrlich
Father of Medicine	Hippocrates
Founder of first Pharmacology Institute	Rudolf Buchheim
Discovery of Penicillin	Alexander Fleming
Discovery of Streptomycin	Selman Waksman
Discovery of Insulin	Banting and Best
Discovery of antimicrobial effect of Prontosil	Gerhard Domagk
Discovery of Homeopathy	Samuel Hahnemann
Discovery of Blood types	Karl Landsteiner
Discovery of Vaccination	Edward Jenner
Discovery of Neurotransmitters	Otto Loewi

❑ ORPHAN DRUGS

- These are drugs used for prevention and treatment of **rare diseases**.
- Orphan drug may be **life-saving drugs** for some patients.
- An orphan drug is one that has special manufacturer economic.

Trick – SR DDLG ka FAN hai		
SR	**DDLG**	**FAN**
Somatotropin, **S**odium nitrite, **R**ifabutin	**D**igoxin antibody, **L**iothyronine (T_3)	**F**omepizole, **A**mphotericin B, **N**itrates

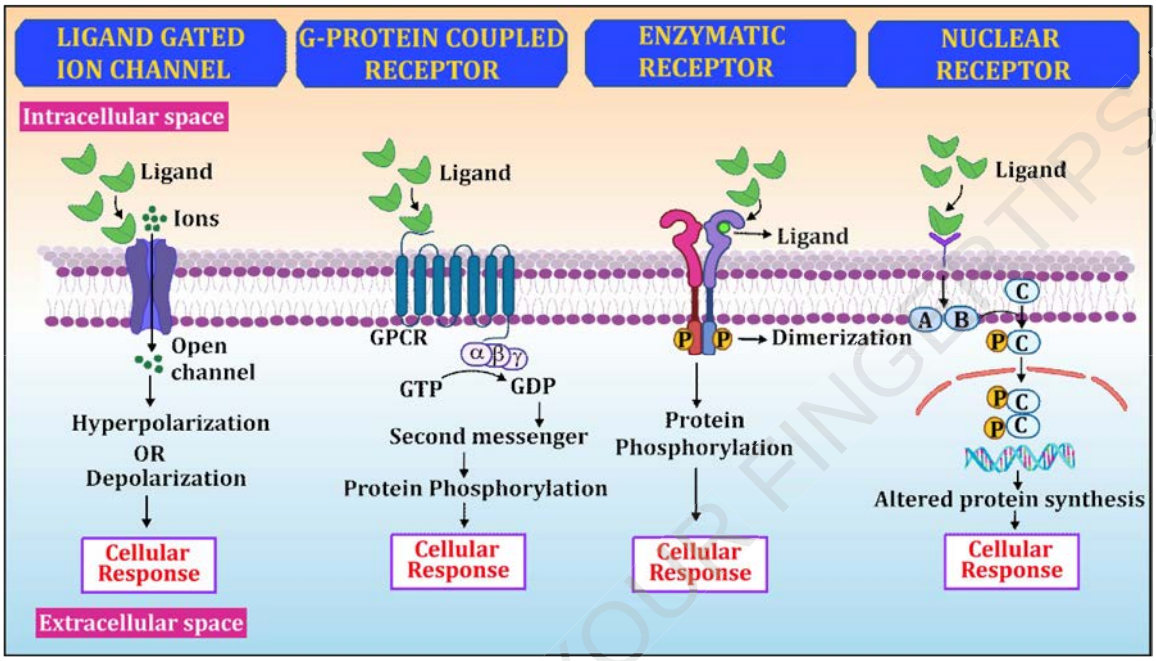
❑ ESSENTIAL DRUGS

- According to WHO, drug that **satisfy priority healthcare and need** of majority of population.
  - ✓ **WHO Model List of Essential Drugs** – 1977 (First), 23rd list 2023 (Latest) → 591 drugs.

➢ Summary of Competitive, Non-Competitive and Uncompetitive Inhibitors

Inhibitors	Bind to	K_M	V_{max}	Example
Competitive	Enzyme	Increase	No change	Physostigmine
Non-Competitive	Both Enzyme and ES complex	No change	Decrease	Cyanide
Uncompetitive	ES complex only	Decrease	Decrease	Lithium

❖ TYPES OF RECEPTORS AND THEIR MECHANISM



Characteristic	Ligand-gated ion Channels	G-protein- coupled Receptors	Enzymatic Receptors	Nuclear Receptors
Time scale	Milliseconds	Seconds	Hours	Hours
Location	Membrane	Membrane	Membrane	Intracellular
Effector	Ion channel	Channel or enzyme	Enzyme	Gene transcription
Coupling	Direct	G-proteins (Gs, Gi, Gq etc.)	Direct	Via DNA
Examples	Nicotinic, $GABA_A$ –receptors	Muscarinic, adrenergic receptors	Insulin, growth factor, cytokine receptors	Steroid, thyroid hormone receptors

- **Ligand-gated ion channels** are fastest acting receptor and **nuclear receptor** is slowest acting.
- **G-Protein coupled receptor** (Metabotropic receptor) and it is also known as heptahelical receptor or serpentine receptor. Largest family of cell membrane receptor.
- **ED_{50}** is a measure of **Potency**. **LD_{50}** is a measure of **Toxicity.**
- Therapeutic index (TI) is an indicator of: **Safety.**

❑ CLINICAL TRIALS

PHASE	NAME	CONDUCTED ON	PURPOSE
0	**Micro-dosing study**	In human less than **1/100th** dose of test substance calculated to produce p'cological effect.	To obtain preliminary Pharmacokinetic data. **Preclinical Data:** Subacute toxicity study in one species by two routes of administration.
I	**Human pharmacology and safety**	Healthy volunteers **(20-80)**	To know maximum tolerable dose (MTD) **Safety and tolerability.**

❑ PHARMACOLOGICAL ACTIONS OF ATROPINE

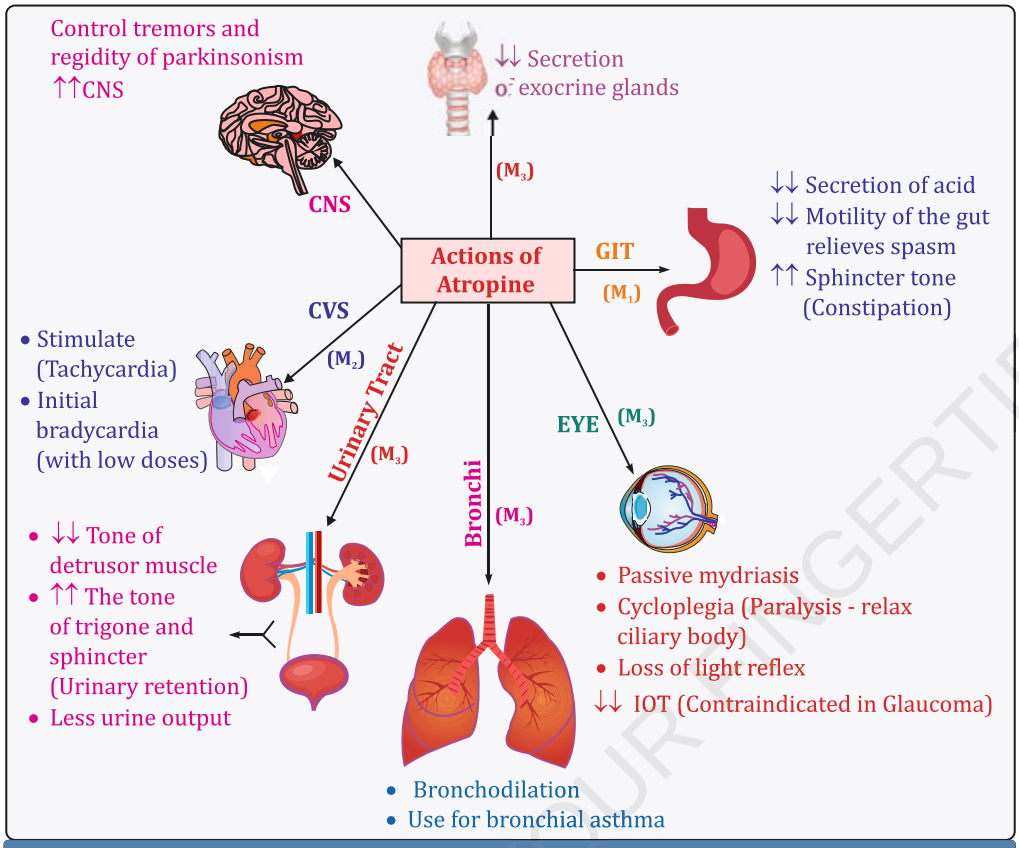


Fig: Pharmacological Actions of Atropine

❑ ANTICHOLINERGIC DRUGS THEIR ACTIONS AND USES

DRUGS	MECHANISM OF ACTION	USES
Atropine (Hyoscyamine) (**ADR-** Cycloplegia (blurred vision), Photophobia, Tachycardia, Urinary retention, Atonia, Psychotic behaviour)	M_3 blocker	Antisecretory (preanesthetic), Mydriatic & Cycloplegic action, Organophosphorus and, Mushroom poisoning, Antispasmodic, Digitalis toxicity
Scopolamine (Hyoscine) (**ADR-** Cycloplegia CNS Depression effect Loss of short-term memory)	M_3 blocker	Marked CNS effect than Atropine, Motion sickness, Antisecretory, NARCO TEST
Homatropine, Cyclopentolate	M_3 blocker	Mydriatic & Cycloplegic action
Ipratropium, Tiotropium Oxytropium	M_3 blocker	Asthma (Bronchodilator)
Cimetropium	M_3 blocker	Reduce tone of GI, Biliary and urogenital tract
Dicyclomine	M_3 blocker	Antispasmodic, Anti-secretory, Motion Sickness
Pirenzepine	M_1 blocker	Peptic Ulcer
Propanthelines	M_3 and M_1 blocker	Anti-Spasmodic, Peptic Ulcer, Adjuvant to X-ray examination of GIT
Benztropine, Trihexyphenidyl Biperiden		Anti-Parkinsonian

❖ PHARMACOLOGICAL ACTIONS OF HISTAMINES

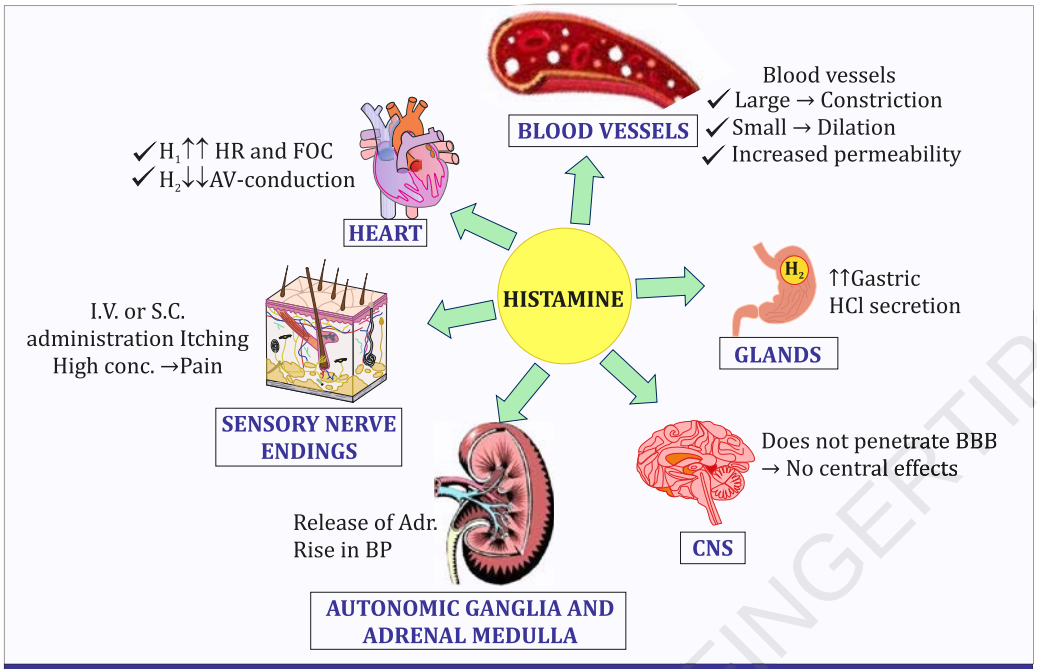


FIG- PHARMACOLOGICAL ACTIONS OF HISTAMINE

❑ ANTIHISTAMINICS (H_1 receptor antagonist/Conventional Antihistaminic)

- H_1 anti-histamine causes sedation, hence patients should be advised not to drive or use motor vehicles that requires constant attention.
- Antihistaminic reduces severity of adverse effects of Dimercaprol injection.

❖ DIFFERENCE BETWEEN 1st AND 2nd GENERATION H_1 RECEPTOR ANTAGONIST

1st GENERATION	2nd GENERATION
They can cross BBB causes	They can't cross BBB
Causes sedation and drowsiness	Not causes sedation and drowsiness
Have anticholinergic action	No anticholinergic action
Side effect- Dryness, blurring of vision, constipation, urinary retention	No side effect
Uses- Antiemetic, Drug induced parkinsonism, Common cold	**Uses-** Rhinitis, Allergy and Inflammation

❖ CLASSIFICATION OF H_1 ANTIHISTAMINIC

CLASS	DRUGS
First generation antihistaminic	
Highly Sedative	Diphenhydramine, Dimenhydrinate, Promethazine, Hydroxyzine
Moderately Sedative	Pheniramine, Cyproheptadine, Meclozine (Meclizine), Cinnarizine, Antazoline, Cyclizine
Mild Sedative	Chlorpheniramine, Dexchlorpheniramine, Triprolidine, Clemastine
Second generation antihistaminic	
Fexofenadine, Loratadine, Desloratadine, Cetirizine, Levocetirizine, Azelastine, Mizolastine, Ebastine, Rupatadine, Terfenadine	

- **Olopatadine** are topical H_1 antihistaminic used by nasal route.
- **Fexofenadine** active metabolite of Terfenadine.

- **Terfenadine** is the fastest acting antihistaminic drug.
- **Loratadine** are long-acting antihistaminic drug.
- **Astemizole** is slowest and longest acting agent and has arrhythmogenic property.
- **Azelastine** has maximum topical activity and used as nasal spray for allergic rhinitis.
- **Alcaftadine** is approved as ophthalmic solution for allergic conjunctivitis.
- **Ebastine** is converted to active metabolite Carbastine.

❖ DRUG CAUSING TORSADE'S DE POINTES

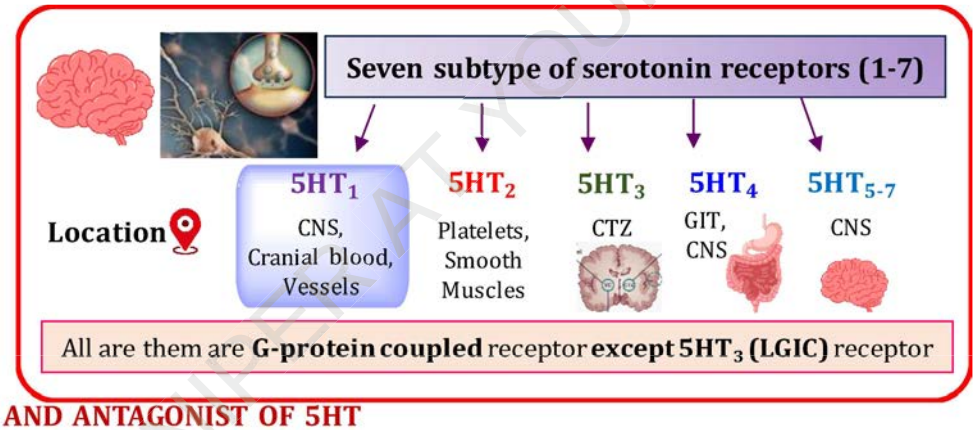
SOME OTHER DRUG THAT PROLONGS Q-T INTERVAL (HAVE POTENTIAL TO PRECIPITATE *TORSADE'S DE POINTES*)	
Antiarrhythmics	Quinidine, Procainamide, Disopyramide Propafenone, Amiodarone
Antimicrobials	Quinine, Mefloquine, Artemisinin, Halofantrine, Sparfloxacin, Gatifloxacin
Antihistaminic	Terfenadine, Astemizole, Ebastine
Antidepressants	Amitriptyline and other Tricyclics
Antipsychotics	Thioridazine, Risperidone
Prokinetic	Cisapride

❑ 5-HYDROXYTRYPTAMINE (5-HT, SEROTONIN)

- 5-HT is **β-aminoethyl-5-hydroxyindole**.
- Synthesized from the amino acid **Tryptophan** and degraded primarily by MAO.

❖ RECEPTORS AND CLASSIFICATION OF SEROTONIN (5-HT) DRUGS

- There are seven subtypes of serotonin receptors ($5HT_1$-$5HT_7$).



❖ AGONIST AND ANTAGONIST OF 5HT

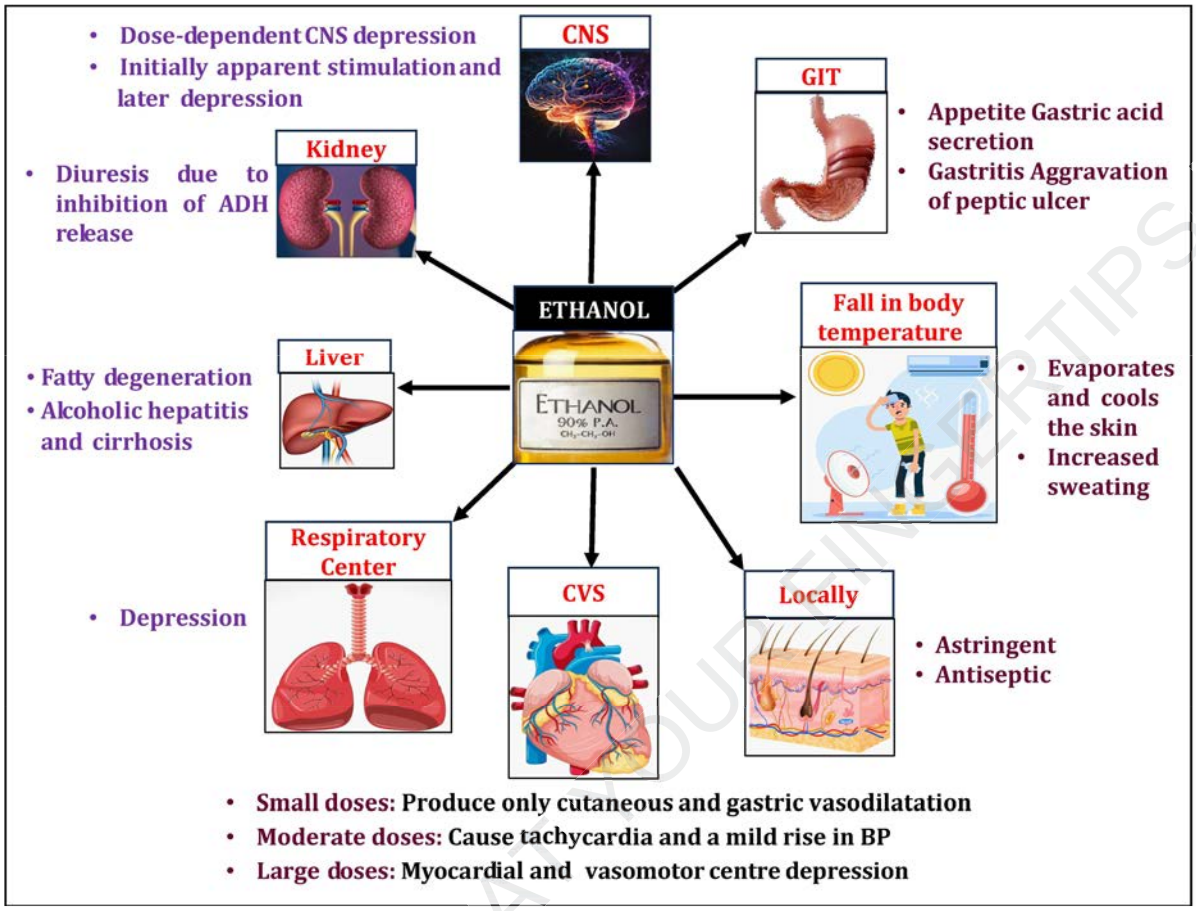
Agonist	$5HT_1$	$5HT_{1A}$	**Buspirone** [Partial agonist] (Anti-anxiety drug)
		$5HT_{1B/1D}$	**Sumatriptan** (Used in migraine)
	$5HT_3$	**2-methyl 5HT**	
	$5HT_4$	**Metoclopramide, Cisapride, Renzapride**	
Antagonist	$5HT_{2A}$	**Ketanserin** (Antihypertensive), **Cyproheptadine**	
	$5HT_{2A/2C}$	**Clozapine, Methysergide** (Used in migraine)	
	$5HT_3$	**Ondansetron, Granisetron** (Choice for chemotherapy induced vomiting)	

❑ ERGOT ALKALOIDS

- They are derived form a fungus ***Claviceps Purpurea*.**
- Considered as **derivative of Lysergic acid.**
- Ergot alkaloids are **partial agonists and antagonists of 5-HT,** α and dopaminergic receptors.
- Ergot alkaloids effectively **cross blood brain barrier.**

ETHYL AND METHYL ALCOHOL

❑ PHARMACOLOGICAL ACTIONS



❑ DRUGS USED IN TREATMENT OF ALCOHOL INTOXICATION

DRUG	MECHANISM OF ACTION
Benzodiazepam	Prevent withdrawal syndrome.
Naltrexone	Opioid antagonist, prevent relapse of alcoholic form.
Acamprosate	NMDA antagonist, used for maintenance therapy.
Ondansetron	5 HT_3 antagonist, blocks action of alcohol.
Disulfiram	Inhibits aldehyde dehydrogenase

❖ DRUGS THAT GIVE DISULFIRAM LIKE REACTION

Acetaldehyde leads to severe distressing symptoms known as **Disulfiram like reaction**.

Mnemonics – Sorry Pluto CaN't Go Mars

Sorry: Sulphonylurea
Pluto: Procarbazine, Phenylbutazone
CaN't: Cefoperazone, Cefamandole, Nitrofurantoin
Go: Griseofulvin
Mars: Metronidazole, Moxalactam

Drugs decreasing alcohol craving
Mnemonics – None Of The Above

None -- Naltrexone
Of -- Ondansetron
The -- Topiramide
Above -- Acamprosate

❑ METHYL ALCOHOL

- Methanol is **highly toxic alcohol**. It is metabolized to **formaldehyde (by alcohol dehydrogenase)** and **formic acid (by acetaldehyde dehydrogenase).**

18.	**A-V block and bradycardia**	Atropine along with cardiac pacing
19.	**For very severe digitalis toxicity**	Digibind
20.	**Hypertensive emergencies**	Nicardipine + Esmolol

Drugs Acting On Kidney

- **Nephron** is the **functional unit of kidney**.
- Diuresis is condition where **urine outflow increases**.
- Urine formation begin with **glomerular filtration (120 ml/min.)**
- Volume filtered is about **180 L/day**.
- Urine excretion is about – **1.5 L/day.**

❑ MECHANISM OF URINE FORMATION

1. Glomerular Filtration 2. Tubular Reabsorption 3. Active Tubular Secretion

❑ SITES OF NEPHRON

1. SITE-I → **Proximal Convoluted Tubule (PCT)**
2. SITE -II → **Thick Ascending Limb (TAL) of Loop of Henle**
3. SITE -III→ **Cortical Diluting Segment of Loop of Henle and early distal tubule**
4. SITE -IV → **Distal Convoluted Tubule (DCT) and Collecting Duct (CD)**

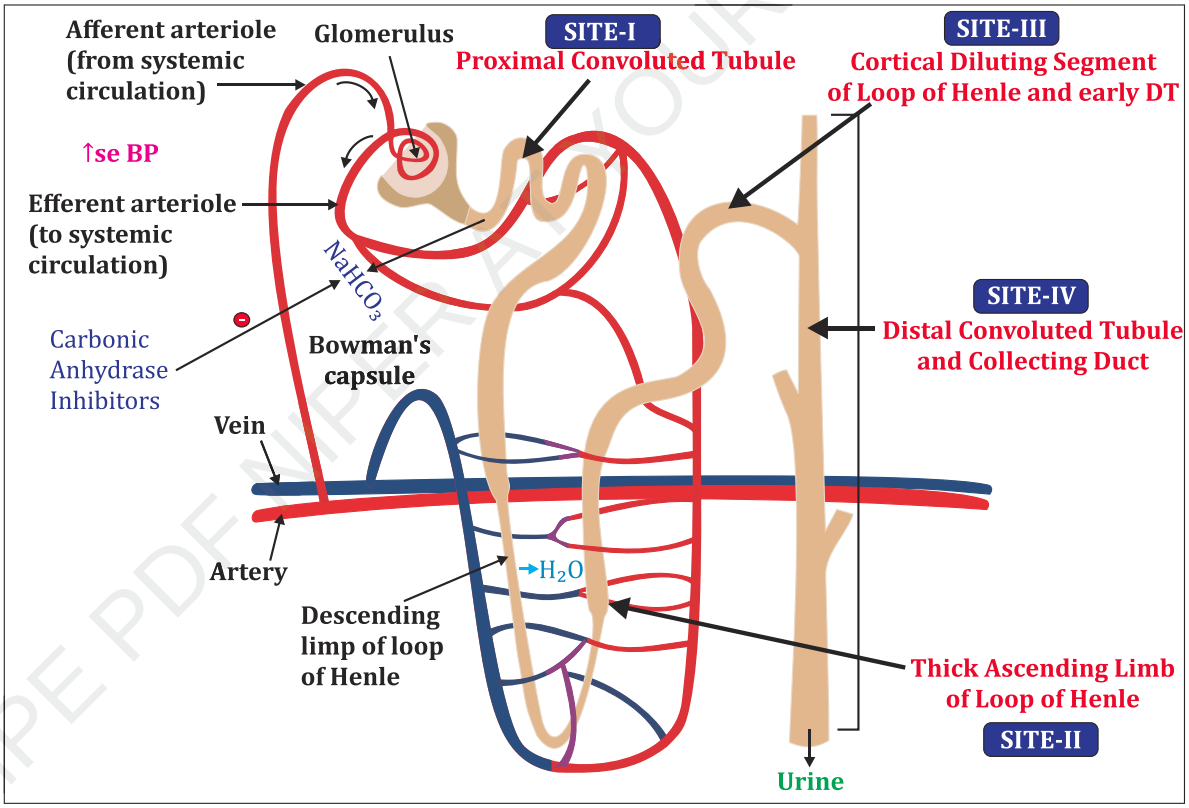


Fig.: Diagrammatical representation of Nephron labeled with their sites

❑ CLASS, SITE OF ACTION AND THEIR MECHANISM OF ACTION

CLASS	SITE OF ACTION	MECHANISM OF ACTION	EFFICACY
Carbonic anhydrase inhibitor (CA)	**Proximal convoluted tubules** **Acting → Site-I**	Inhibition of bicarbonate reabsorption	Low

Physical Chemistry

States of Matter

❑ INTERMOLECULAR FORCES

- The forces of attraction existing among the molecules of a substance (Gaseous, Liquid and Solid) are called intermolecular forces.
- The different types of intermolecular forces are:

INTERMOLECULAR FORCES	DEFINITION
Dispersion forces or London forces	Dispersion forces or London forces are present among non-polar atoms and molecules.
Dipole-dipole interactions	Dipole-dipole forces act between the molecules possessing permanent dipoles.
Dipole-induced dipole forces	They act between the polar molecules having permanent dipole and the molecules lacking permanent dipole.
Hydrogen bond	This is found in the molecules in which highly polar N-H, O-H or H-F bonds are present.

❑ GAS LAWS

LAW	DESCRIPTION	RELATION
BOYLE'S LAW	The volume of a given mass of a gas is inversely proportional to its pressure at constant temperature.	$V \propto \frac{1}{P}$ $P_1V_1 = P_2V_2$
CHARLE' S LAW	The volume of a given mass of a gas is directly proportional to its absolute temperature at constant pressure.	$V \propto T$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
GAY LUSSAC'S LAW	The pressure of a given mass of a gas at constant volume is directly proportional to absolute temperature.	$P \propto T$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$
AVOGADRO'S LAW	It states that equal volumes of all gases under the same conditions of temperature and pressure contain equal number of molecules.	$V \propto n$ $\frac{V}{n} = K$

❑ IMPORTANT EQUATION

LAW	DESCRIPTION
Dalton's law of partial pressure	• At constant temperature, the total pressure exerted by a mixture of non-reacting gases is the sum of partial pressures of different gases present in the mixture. • $P = P_1 + P_2 + P_3 + \ldots\ldots$

❑ DIFFERENCE BETWEEN EXOTHERMIC AND ENDOTHERMIC

EXOTHERMIC REACTION	ENDOTHERMIC REACTION
• A reaction that releases energy. • The reactants have more energy than the products. • Energy must be released as the products form. • The container in which an exothermic reaction is taking place will feel warm.	• A reaction that absorbs energy. • The products have more energy than the reactants. • Energy must be absorbed as the products form. • The container in which an endothermic reaction is taking place will feel cold.

Electrochemistry

TERMS	DESCRIPTION
Electrolyte	• Strong electrolyte: electrolytes which are completely ionized in aqueous solution are called strong electrolytes. **Eg** - Salts, strong acids and strong bases • Weak electrolyte: electrolytes which are not completely ionized in aqueous solution are called weak electrolytes. **Eg** - CH_3COOH
Electrolysis	• It is the process of decomposition of an electrolyte when electric current is passed through either its aqueous solution or molten state.
FARADAY'S LAWS OF ELECTROLYSIS	
First law	• The amount of the substance deposited or liberated at cathode is directly proportional to the quantity of electricity passed through an electrolyte. $W \propto Q$
Second law	• When the same quantity of electricity is passed through different electrolytes, the amounts of the substance deposited or liberated at the electrodes are directly proportional to their equivalent weights. $\frac{W_1}{W_2} = \frac{E_1}{E_2}$

❑ REFERENCE ELECTRODE

- The potential of a single electrode cannot be determined but the potential difference between two electrodes can be accurately measured using a reference electrode.

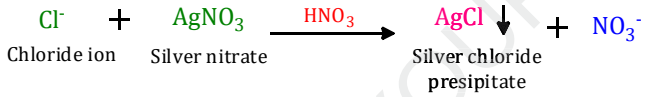
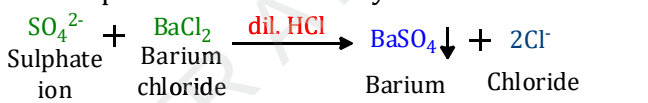
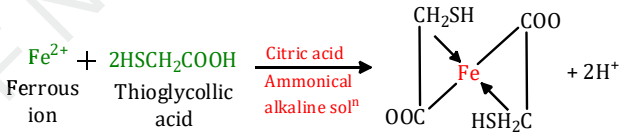
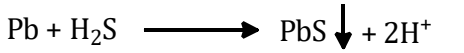
❑ ELECTROLYTIC CONDUCTANCE

Resistance (R)	• Resistance of a conductor is the ratio of the applied potential difference (V) to the current (I) flowing. • R is expressed in ohms. • $R = \frac{V}{I}$
Specific resistance/ resistivity (ρ)	• The resistance (R) of a conductor is directly proportional to its length (l) and inversely proportional to its area of cross section (A). • Unit of ρ = ohm cm • $R = \rho \frac{l}{A}$
Conductance	• The conductance of a conductor is equal to reciprocal of resistance. • $G = \frac{1}{R}$ • Unit of G is mho or ohm^{-1} or Siemens (S).
Specific conductance / Conductivity (κ)	• Reciprocal of specific resistance. • $\kappa = \frac{1}{\rho}$ Unit of k is $ohm^{-1}\ cm^{-1}$

❑ LIMIT TEST

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

❖ LIMIT TEST OF DIFFERENT COMPOUNDS

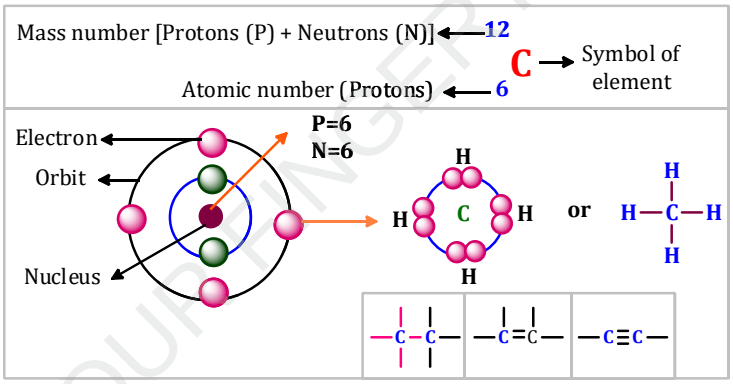
SUBSTANCE	PRINCIPLE/ REACTION	RESULT
CHLORIDE	Limit test of chloride based on reaction between **chloride ion** and **silver nitrate** in the presence of **dilute nitric acid.** 	• Reaction produces silver chloride **as precipitate.** • Opalescence produce in sample solution should not be greater than standard solution.
SULPHATE	Limit test of sulphate depends upon the interaction of sulphates with barium chloride in the presence of hydrochloric acid. 	• This result in the precipitation of sulphates as barium sulphate.
IRON	Limit test of iron based on reaction between **iron interact** with **thioglycolic acid** in the presence of **citric acid** and **ammonical alkaline solution.**  Ferrous thioglycolate (Purple colour complex)	• Reaction produces **iron thioglycolate complex as purple color.** • Citric acid form soluble complex with iron and **prevent precipitation**.
HEAVY METAL	Limit test of heavy metal based on reaction between **metal impurities** and **hydrogen sulphide** in **acidic medium.**  **Lead sulphide (brown colour)**	• **To produce metal sulphide** as per reagent. • These remain distributed in colloidal state and produce brownish colour. • The usual limit as per **Indian pharmacopoeia is 20 ppm.**

Organic Chemistry

Introduction of Organic Chemistry

❖ INTRODUCTION

- Organic chemistry is the major branch of chemistry which deals with the scientific study of preparation, structure, properties, composition and reactions of carbon containing compounds.



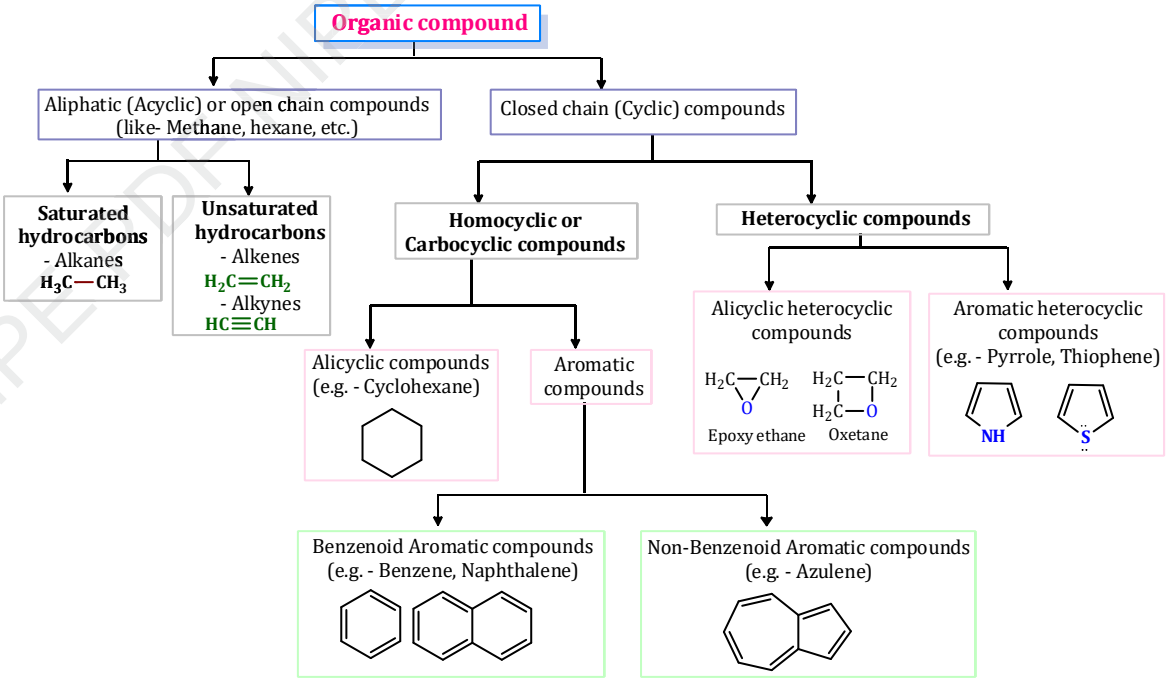
➢ CHARACTERISTICS OF CARBON ATOMS

- **Atomic number of Carbon - 6**
- Electronic configuration is 2,4
- **Valence of electrons - 4**
- Tendency to form multiple bonds
- Due to tetravalency of carbon it has a **tetrahedron shape.**

Classification and Nomenclature

(A) Classification Based on Structure

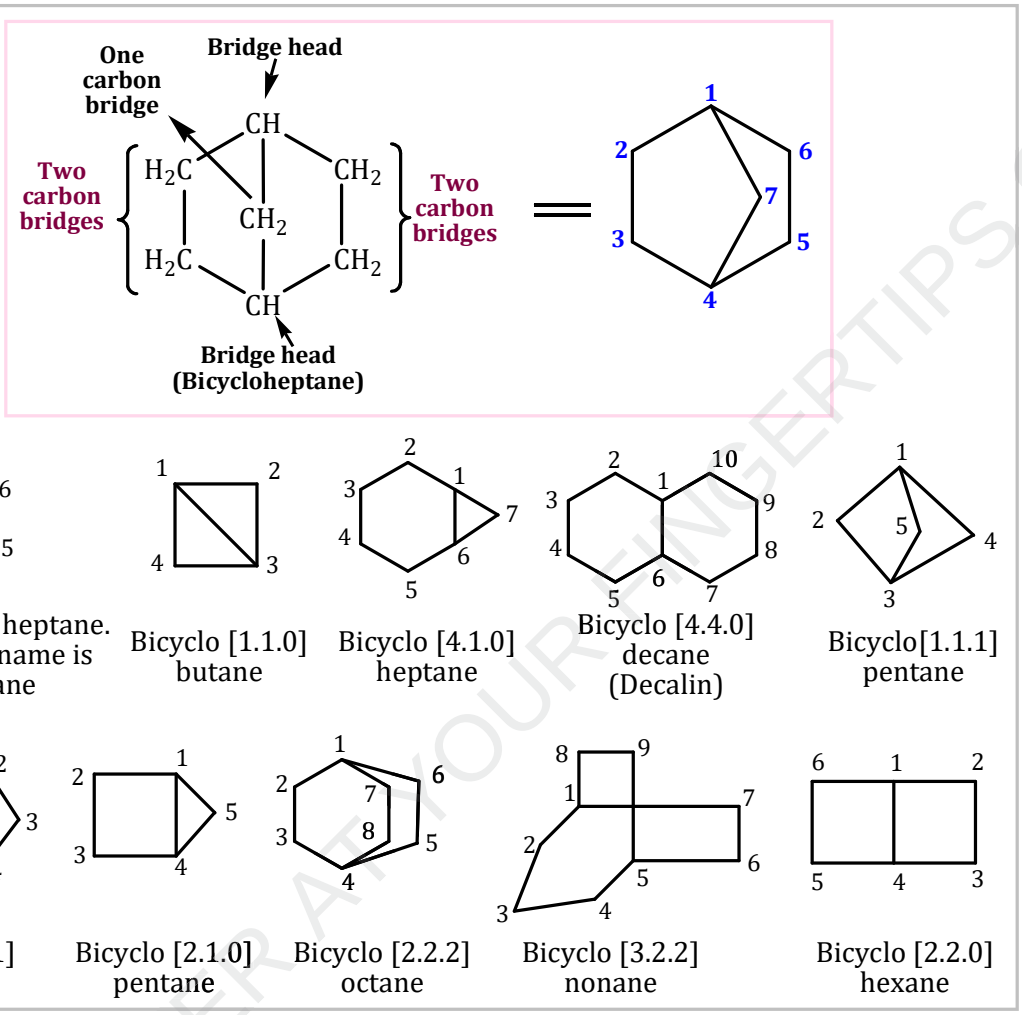
- All the known organic compounds have been divided into two main types:



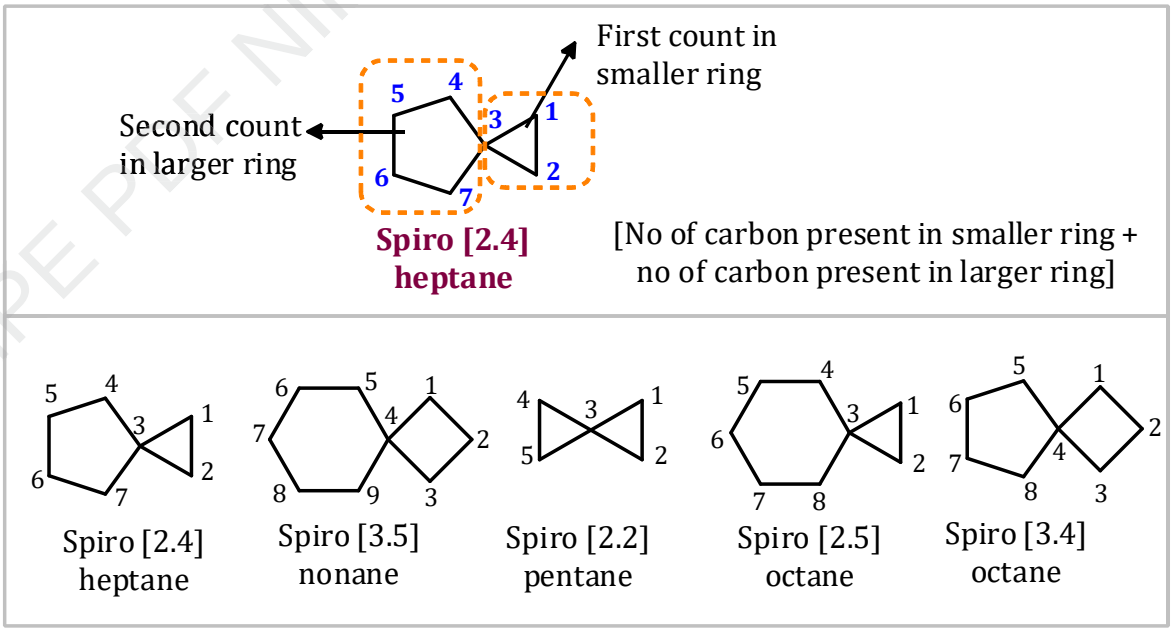
❒ NOMENCLATURE OF BICYCLO AND SPIRO COMPOUNDS

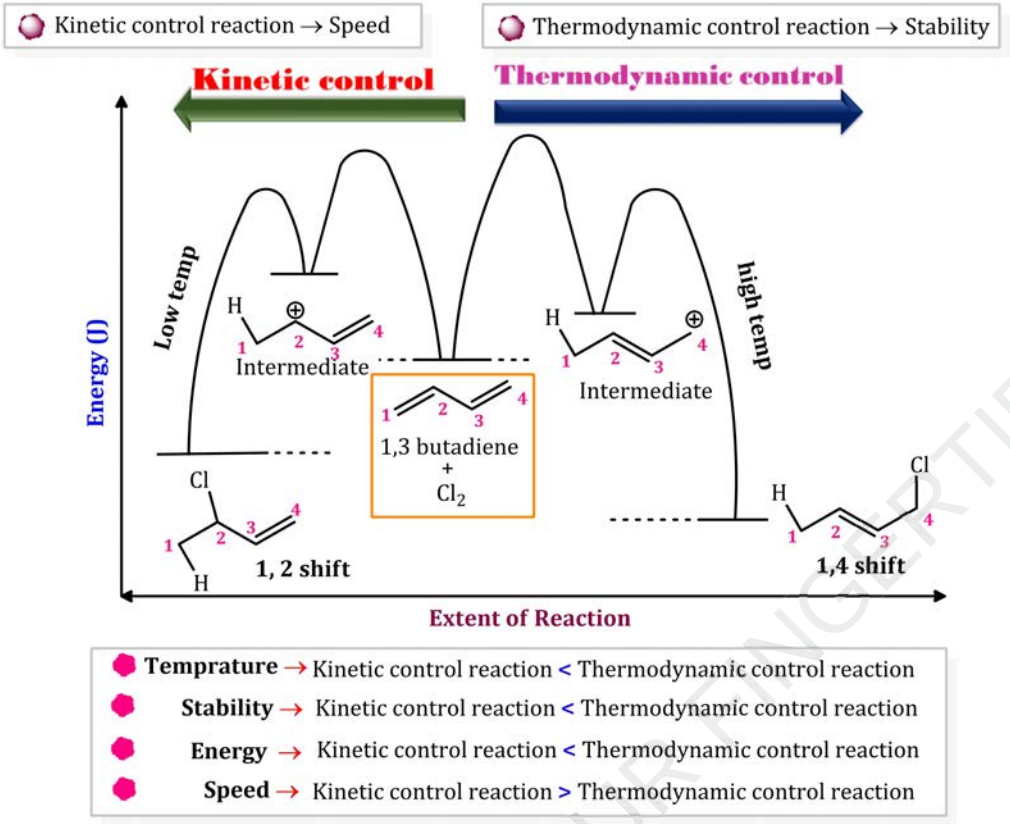
➢ BICYCLO COMPOUNDS

- Bicyclo compounds contain two fused rings with the help of a bridge.



➢ SPIRO COMPOUNDS





TEMPERATURE	1,2 ADDITION	1,4 ADDITION
0°C	70%	30%
40°C	20%	80%
60°C	10%	90%
80°C	5%	95%
< 0 → 1,2 addition (Major product) > 0 → 1,4 addition (Major product)		

Isomerism

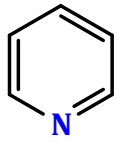
❒ INTRODUCTION

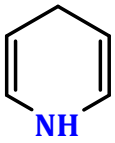
- Organic compounds having **same molecular formula but differing** from each other at least in some physical or chemical properties or both are known as isomers (Berzelius) and the phenomenon is known as isomerism.
- The difference in properties of isomers is due to the difference in the relative arrangements of various atoms or groups present in their molecules.

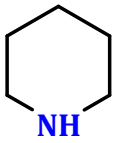
✓ **There are two main types of isomerism:**

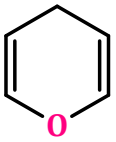
1. Structural isomerism/constitutional isomerism
2. Stereoisomerism/ Space isomerism

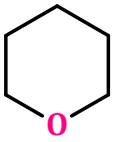
6-Membered Rings with one Heteroatom

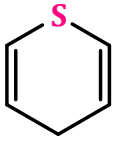

Pyridine


Dihydro Pyridine

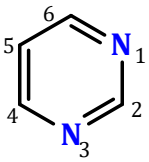

Piperidine

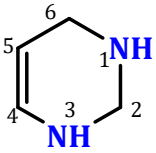

Pyran

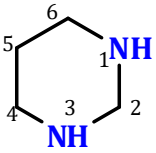

Oxane

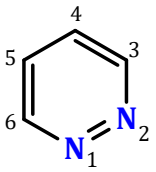

4H-thiopyran

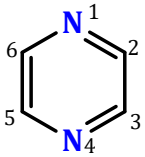
6-Membered Rings with two Heteroatom


Pyrimidine


Tetrahydro pyrimidine

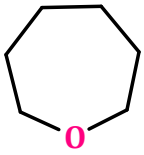

Perhydro Pyrimidine

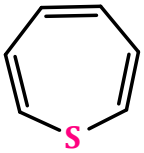

Pyridazine

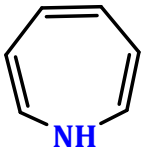

Pyrazine

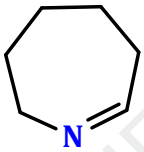

Piperazine

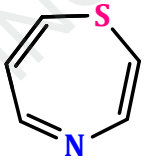
7-10 Membered Rings with one heteroatom

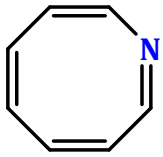

Oxepane

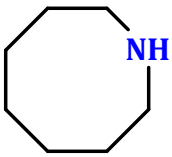

Thiepine

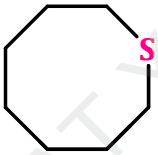

Azepine

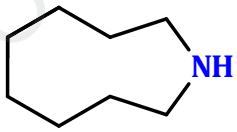

3,4,5,6-tetrahydro-2H-azepine

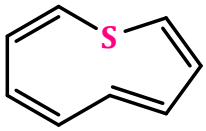

1,4-thiazepine


Azocine

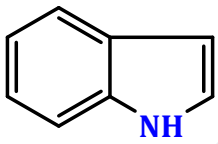

Azocane

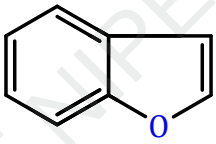

Thiocane

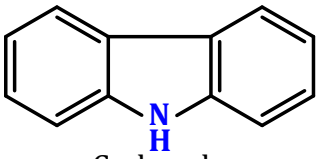

Azonane

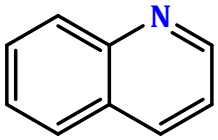

Thionine

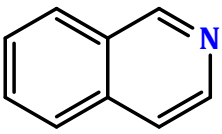
Partly carbocyclic and Partly heterocyclic


Indole

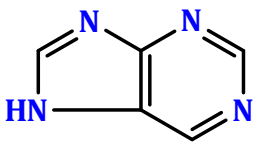

Benzofuran

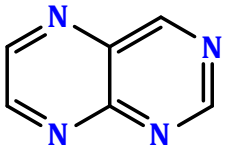

Carbazole


Quinoline


Isoquinoline

Completely heterocyclic


Purine


Pteridine

Fused or condensed heterocyclic compounds

❖ Systematic method of Nomenclature

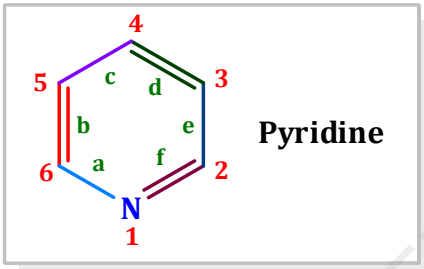
- The **Hantzsch-Widman system** is the most widely used nomenclature system for monocyclic heterocyclic compounds, especially for ring systems with three to ten members.

RING SIZE	3	4	5	6	7	8	9	10
SUFFIX	ir	et	ol	in	ep	oc	on	ec

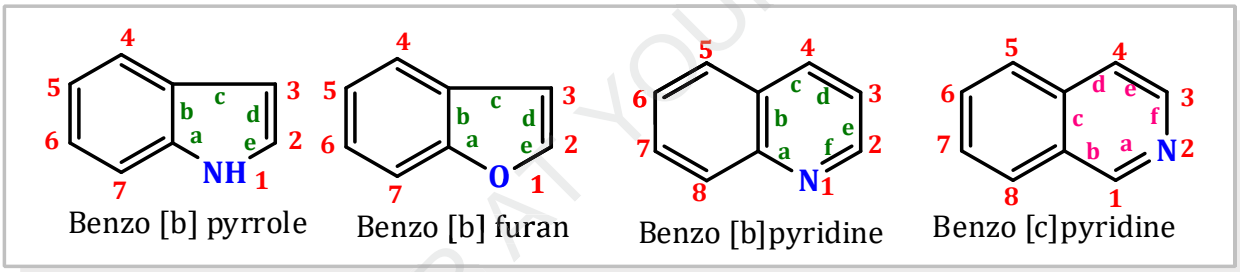
6	-ine	-inane	-ine	-inane
7	-epine	-epane	-epine	-epane
8	-ocine	-ocane	-ocine	-ocane
9	-onine	-onane	-onine	-onane
10	-ecine	-ecane	-ecine	-ecane

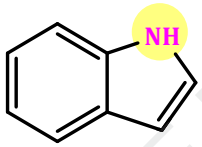
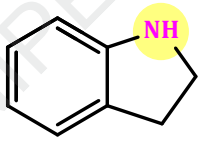
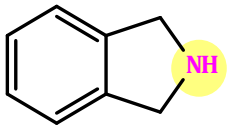
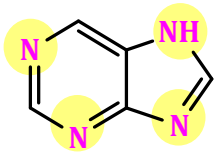
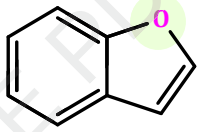
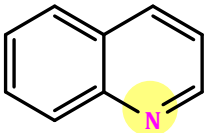
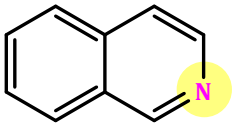
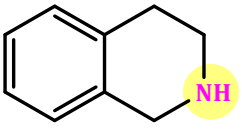
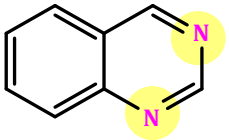
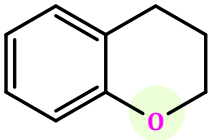
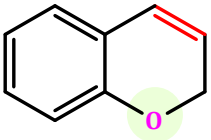
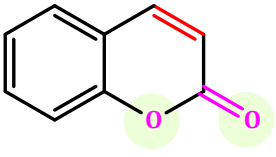
❖ Naming Heterocycles with fused rings

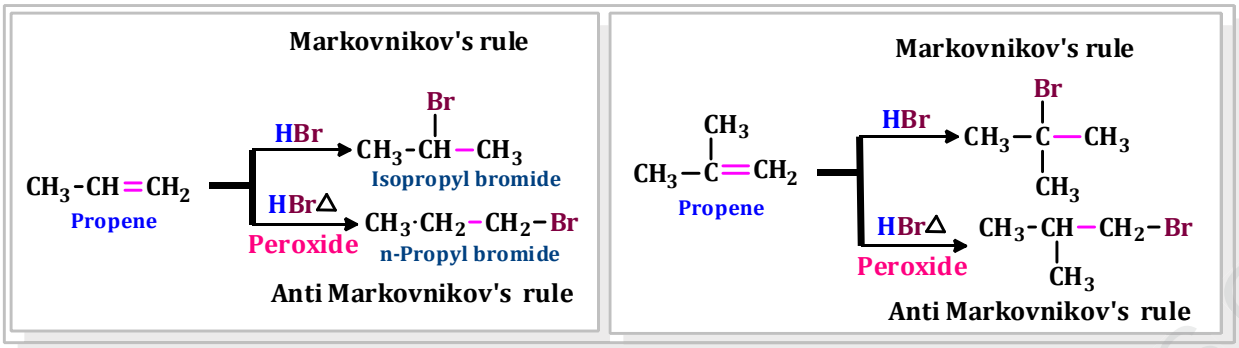
- When naming such compounds, the side of the heterocyclic ring is labeled by the letters a, b, c, etc., starting from the atom numbered 1.
- Therefore side 'a' being between atoms 1 and 2, side 'b' between atoms 2 and 3, and so on as shown below for pyridine.



- The name of the heterocyclic ring is chosen as the parent compound and the name of the fused ring is attached as a prefix. The prefix in such names has the ending 'o', i.e., benzo, naphtho and so on.

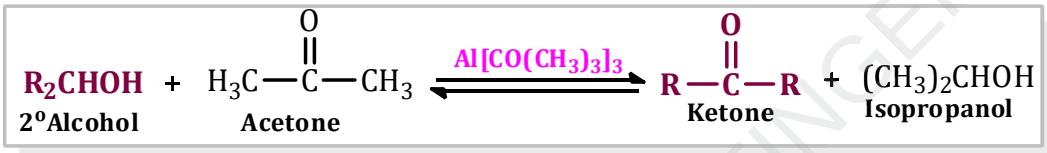


FUSED POLYCYCLIC SYSTEM			
 Indole (C_8H_7N)	 Indoline (C_8H_9N)	 Isoindoline (C_8H_9N)	 **Purine** ($C_5H_4N_4$)
 Benzofuran (C_8H_6O)	 Quinoline (C_9H_7N)	 Isoquinoline (C_9H_7N)	 Tetrahydro isoquinoline ($C_9H_{11}N$)
 Quinazoline ($C_8H_6N_2$)	 Chromane ($C_9H_{10}O$)	 Chromene (Benzopyran) (C_9H_8O)	 Coumarin ($C_9H_6O_2$)



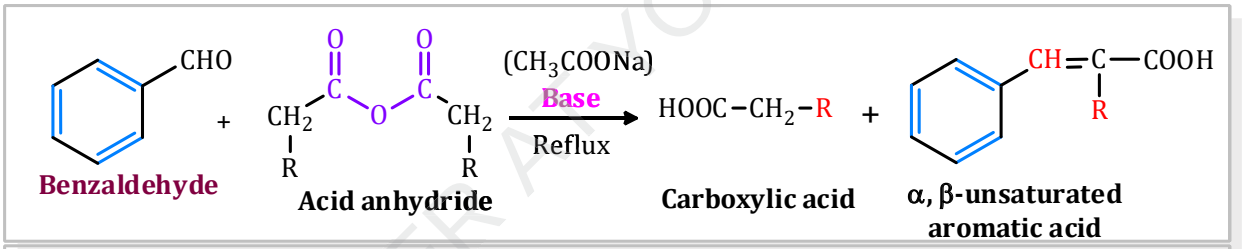
❖ OPPENAUER OXIDATION

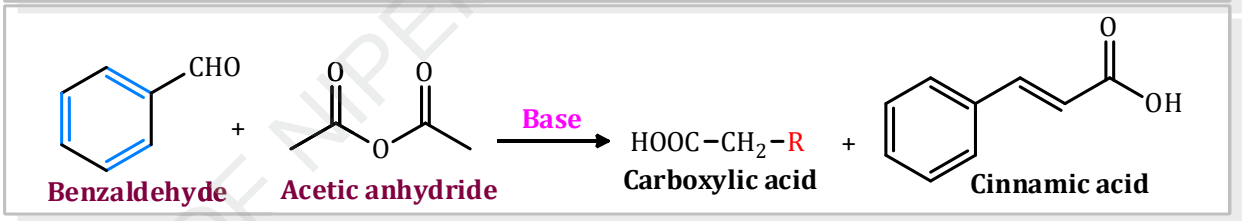
- It is the reverse reaction of Meerwein-Ponndorf-Verley reduction.
- It involves the oxidation of alcohols (2° alcohols) in to **ketones in the presence of aluminium tertiary butoxide in toluene or benzene.**



❖ PERKIN REACTION

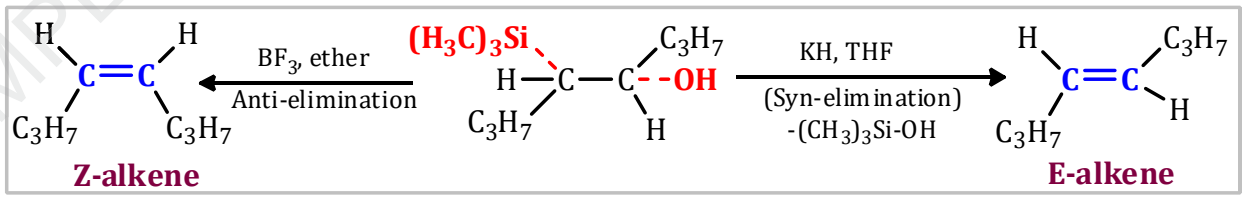
- When an **aromatic aldehyde** is heated with an **aliphatic acid anhydride with atleast two α-H** atom in presence of Na or K salt of corresponding acid, a condensation reaction giving **α, β-unsaturated acid is formed.**





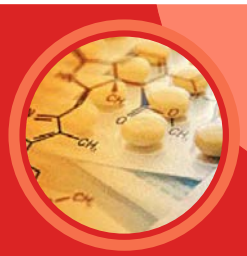
❖ PETERSON REACTION

- **β-Hydroxy alkyl silane** gives **elimination reaction** in presence of acid as well as base.
- It is stereoselective of E- and Z- isomers of alkene.



❖ PINACOL-PINACOLONE REARRANGEMENT

- Fully substituted **1,2-diols (Pinacol)** reacts with mineral acid to form ketone (pinacolone), this is called as Pinacol-Pinacolone rearrangement (dehydration followed by rearrangement occurs).



Medicinal Chemistry

❑ MEDICINAL CHEMISTRY

Medicinal chemistry is the science, which deals with the discovery and design of new and better therapeutic chemicals and development of these chemicals into new medicines and drugs.

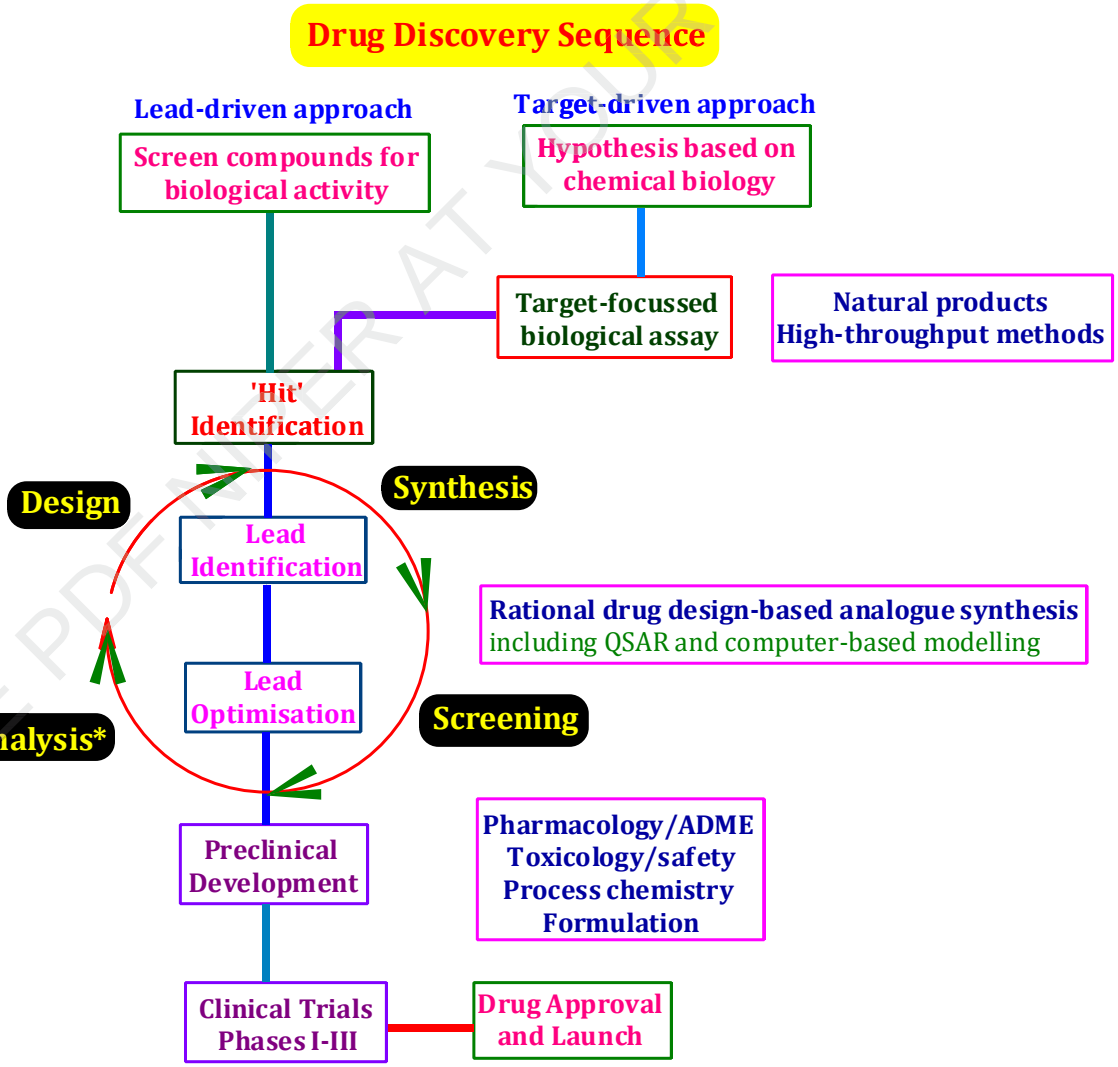
❑ DRUG DESIGN

Drug design may be defined as effort to develop a new drug by molecular modification of lead compound for optimization of desired effects and minimization of side effects.

❖ LEAD COMPOUND/PARENT COMPOUND

A lead compound is a compound having a particular biological activity obtained either from natural or synthetic source.

❖ DRUG DISCOVERY SEQUENCE



Analytical Method Validation

S. NO	PART	DETAILS
1	Accuracy	The accuracy of an analytical procedure expresses the closeness of agreement between the value which is accepted either as a conventional true value or an accepted reference value and the value found.
2	Specificity	Specificity is the ability to assess unequivocally the analyte in the presence of components which may be expected to be present. Typically, these might include impurities, degradants etc.
3	Precision	The precision of an analytical procedure expresses the closeness of agreement.
4	Repeatability	Repeatability expresses the precision under the same operating conditions over a short interval of time.
5	Intermediate precision	Intermediate precision expresses within-laboratories variations: different days, different analysts, different equipment, etc.
6	Reproducibility	Reproducibility expresses the precision between laboratories (collaborative studies, usually applied to standardization of methodology).
7	Detection Limit	The detection limit of an individual analytical procedure is the lowest amount of analyte in a sample which can be detected.
8	Quantitation Limit	The quantitation limit of an individual analytical procedure is the lowest amount of analyte in a sample which can be quantitatively determined with suitable precision and accuracy.
9	Linearity	The linearity of an analytical procedure is its ability (within a given range) to obtain test results which are directly proportional to the concentration (amount) of analyte in the sample.
10	Range	The range of an analytical procedure is the interval between the upper and lower concentration (amounts) of analyte in the sample.
11	Robustness	The robustness of an analytical procedure is a measure of its capacity to remain unaffected by small, but deliberate variations in method parameters.

TITRATION

❑ ACID BASE TITRATION

➢ Summary of Acid – Base theory

THEORY	ACID	BASE
Arrhenius theory	Hydrogen ion donor	Hydroxide ion donor
Bronsted–lowery theory	Proton donor	Proton acceptor

➢ Comparison between TLC and HPTLC

PARAMETER	TLC	HPTLC
Technique	Manual	Instrumental
Efficiency	Less	High
Layer	Lab made/ pre-coated	Pre-coated
Mean particle size	10-12 µm	5-6 µm
Layer thickness	250 µm	100 µm
Plate height	30 µm	12 µm
Solid support	Silica gel, Alumina, Kieselguhr	Silica gel – Normal phase C_8 and C_{18} – Reverse phase

❑ HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

CHARACTERISTIC	NORMAL PHASE	REVERSE PHASE
Stationary phase	Polar (Silica gel)	Non polar (Octadecyl silane C_{18})
Mobile phase	Non polar	Polar
Mechanism	Adsorption	Partition
Compound eluted first	Non polar	Polar

INSTRUMENTS	DESCRIPTION
Pump	1. Constant pressure pump 2. Constant flow pump
Sample injection system	1. Sample injectors 2. Stop flow injection 3. Micro volume sampling volve
Analytical column	Column material: Stainless steel, glass, polyethylene, and PEEK (polyether ether ketone). Column length: 10 cm to 30 cm Column diameter: 4 mm to 5mm Particle size: 1µ to 20µ Particle nature: Spherical, uniform-sized, porous materials are used. Surface area: 1 gram of stationary phase -100-860 sq.m

➢ TYPE OF DETECTORS USED IN HPLC

DETECTORS	DESCRIPTIONS	EXAMPLES
Selective detectors (Solute property)	Respond to a particular physical or chemical property of the solute, being ideally independent of the mobile phase.	Absorbance detectors, Fluorescence detectors, electrochemical detectors, Mass spectrometric detectors.
Universal detectors (Bulk property)	Measure the difference in some physical property of the solute in the mobile phase compared to the mobile phase alone.	Refractive index detectors.

➢ DETECTORS USED IN HPLC

S. NO	DETECTORS	TYPES OF COMPOUNDS TO BE DETECTED
1	UV / Visible	Compounds having chromophores, aromatic rings or alternative double bonds
2	Refractive index	Fluorescent compounds with fused rings or conjugated systems
3	Conductivity Detectors	Charged compounds such as inorganic compounds and organic acids

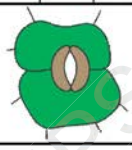
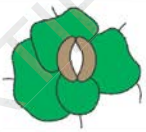
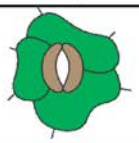
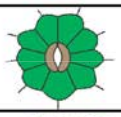
Pharmacognosy

Introduction of Pharmacognosy

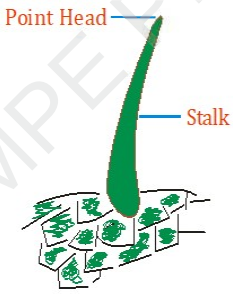
❑ HISTORICAL DEVELOPMENT OF PHARMACOGNOSY

SCIENTIST	CONTRIBUTION	SCIENTIST	CONTRIBUTION
Dioscorides	**Father of Pharmacognosy Written a Book Materia Medica**	**Seydler**	Seydler coined the term **"Pharmacognosy"** in 1815 in the title of his work ***"Analecta Pharmacognostica".***
George Ebers	**Papyrus Ebers-** Oldest document containing **700 medicinal herbs** and more than 870 formulae.	**Shen Nung**	**Pen-t Sao** (The oldest known herbal) Contain 365 drugs one for each day of the year.
Swede Linnaeus	Classified plant **(Binomial nomenclature)**	**Charaka**	**Charaka Samhita** - Arranged 50 group of 10 Herbs.
Theophrastus	**Father of Botany**	**Sushrutha**	**Sushrutha Samhita** Father of Cosmetic Surgery
Aristotle	**Father of Zoology,** Wrote on animal kingdom.	**Berg**	**Anatomical Atlas** of crude drug was published.
Hippocrates	**Father of Medicine** Contribution on anatomy and physiology of human beings.	**Greenish & Collin**	Anatomical Atlas of powdered **vegetable drug.**
Galen	**First pharmacist,** Father of Experimental Physiology	**N. Le'mery**	Reported importance of extraction method and **alcohol to be use as ideal solvent.**
Edward Bach	Discovery of **Bach flower remedies.**	**Gantle Fosse**	Coined the term **'Aromatherapy'.**
Stass and Otto	A **new extraction process** for Alkaloid and glycosides was developed.	**G. Mendal**	Important observation on plant **hybrid were published.**
Mahadeva Lal schroff	**Father of Indian Pharmacy** His birth anniversary (06 march) celebrated as "National Pharmacy Education Day"	**Haberblandt**	**Father of Plant Tissue Culture** Introduced term totipotency.

➢ Stomata

TYPES OF STOMATA			
STOMATA	**DESCRIPTION**	**EXAMPLE**	**DIAGRAM**
Paracytic /Rubiaceous /Parallel Celled **stomata**	Two guard cell covered by the two subsidiary cell long axis of which are which are parallel to that stoma	Senna, Coca	
Diacytic/ Caryophyllaceous / Cross celled **stomata**	Guard cell covered by the two subsidiary cell long axis of which are right angle to that of stomata	Spearmint, Peppermint, Vasaka, Thyme	
Anomocytic/ Ranunculaceous/ Irregular celled **stomata**	Stomata covered by varying number of subsidiary cell	Buchu, Clove, Opium, Digitalis, Fennel, Lobelia	
Anisocytic / Cruciferous/ Unequal celled **stomata**	Guards cell are two but subsidiary cell three and one is small than other two	Vinca, Belladonna, Datura, Stramonium	
Actinocytic / Radiate celled **stomata**	Two guard cell are covered by circle radiating subsidiary cell	Bear berry	
Sunken stomata	Found in xerophytes, in a small pit, which prevent loss through transpiration	Ephedra	
Circular stomata	A circular pore with a hole in the middle for gas to enter or leave the plant	Colchicum, Squill	

➢ Trichomes

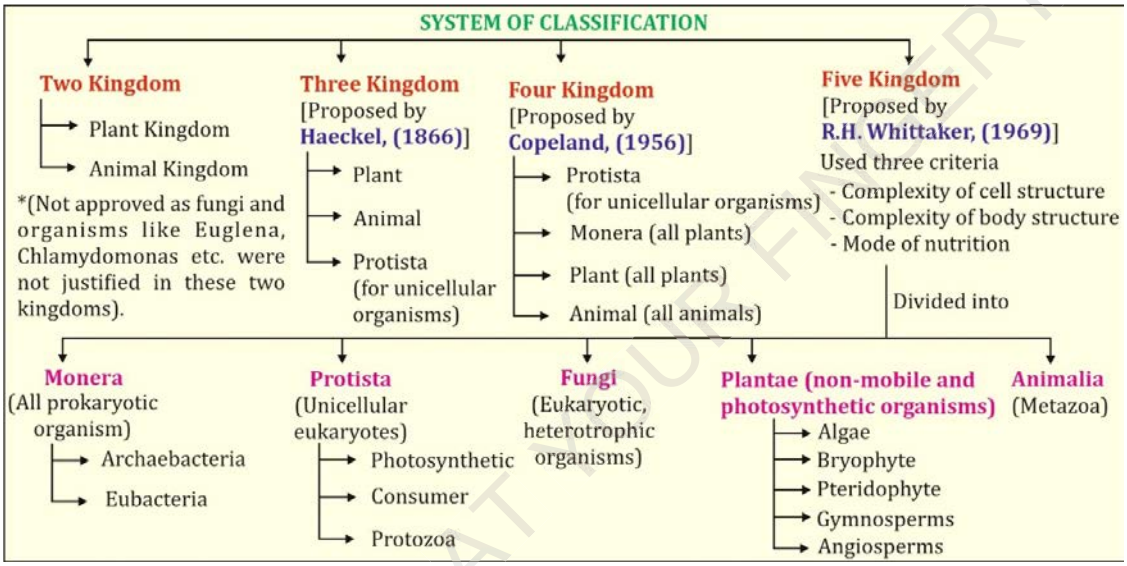
Covering or Non glandular or clothing trichomes 	**Unicellular trichomes**	• **Lignified trichomes:** Nux-vomica, Strophanthus • **Short, Sharp, Pointed, Curved:** Cannabis • **Large, Conical, Strongly Shrunken:** Lobelia • **Short, Conical unicellular:** Tea, Buchu • **Short, Conical, Warty:** Senna • **Long tubular, flattened, twisted:** Cotton
	Multicellular trichomes	**(A) Multicellular unbranched trichomes** **(i) Uniseriate**: Bi-cellular, conical - **Datura** Three celled long - **Stramonium** Three to four celled long - **Digitalis** Four to five celled long – **Belladonna** **(ii) Biseriate** - ***Calendula officinalis*** **(iii) Multiseriate – Male fern** **(B) Multicellular branched trichomes** **i. Stellate:- Hamamelis**, ***Helicteris isora*** **ii. Peltate** (Plate like structure)**:- Humulus** **iii. Candelabra :-** ***Verbascum thapsus*** **iv. T-shaped trichomes:- Pyrethrum, Artemisia**

WILD CHERRY BARK 	**Synonym:** Virginian prune Bark, Wild Black Cherry. **Biological source:** Wild cherry bark is the dried bark of ***Prunus serotina.*** **Family:** Rosaceae **Chemical constituents:** Prunasin (Mandelonitrile glucoside) $\text{Prunasin} \xrightarrow[H_2O]{\text{Prunase}} \text{Benzaldehyde} + \text{Glucose} + \text{Hydrocyanic acid}$ **Uses:** It is used as expectorant
GINKGO 	**Synonyms:** Maiden hair Tree, Kew Tree. **Biological source:** Ginkgo consist dried leaves of ***Ginkgo biloba.*** **Family:** Gingkoaceae **Chemical constituents:** **Diterpene lactones** - Ginkgolides A, B, C and J, anthocyanins. **Uses:** Raynaud's disease, Ginkgolide is a potent inhibitor of Platelet Activating Factor (PAF)
SILYMARIN 	**Synonyms:** Milk-thistle **Biological source:** Silymarin are the ripe seeds of Milk thistle ***Silybum marianum.*** **Family:** Asteraceae (Compositae). **Chemical constituents:** Silymarin
BUCK WHEAT 	**Biological source:** It is the powder of dried food grains of ***Fagopyrum esculentum.*** **Family:** Polygonaceae. **Chemical constituents:** Rutin (Hesperidin and Vitamin P) **Uses:** Useful in treating capillary bleeding
PSORALEA 	**Synonyms:** Bavchi, Malaya tea. **Biological source:** dried ripe fruits of the plants known as ***Psoralea corylifolia*** **Family:** Leguminosae. **Chemical constituents:** **Coumarin compounds** - Psoralen, Psoralidin and Corylifolin. **Uses:** In treatment of leucoderma.
AMMI MAJUS 	**Synonyms:** Bishop's weed, Toothpick Arami. **Biological source:** Obtained from fruits of ***Ammi majus*** **Family:** Umbelliferae. **Chemical constituents:** • The active ingredient- **Xanthotoxin** (0.4 to 1.9 %). • The other ingredients are bergapten, isopimpilin and imperatorin. **Uses:** Used in the treatment of leukoderma by increases the melanin pigment in the skin.
VISNAGA 	**Synonyms:** Khella, Pick tooth fruit. **Biological source:** Visnaga are dried ripe fruits of ***Ammi visnaga*** **Family:** Umbelliferae. **Chemical constituents:** Khellin (bitter tasting crystals, 2-methyl -5, 8 dimethoxy furanochrome), Visnagin and Khelloside. **Uses:** Used as a smooth muscle relaxant.
VANILLA 	**Biological source:** Vanilla consists of cured, fully grown, unripe fruits of ***Vanilla planifolia.*** **Family:** Orchidaceae. **Chemical constituents:** • Fruit Contains 2% Vanillin (4-hydroxy 3-methoxy benzaldehyde) • Vanillin is largely prepared from eugenol.

Human Anatomy & Physiology and Pathophysiology

Introduction

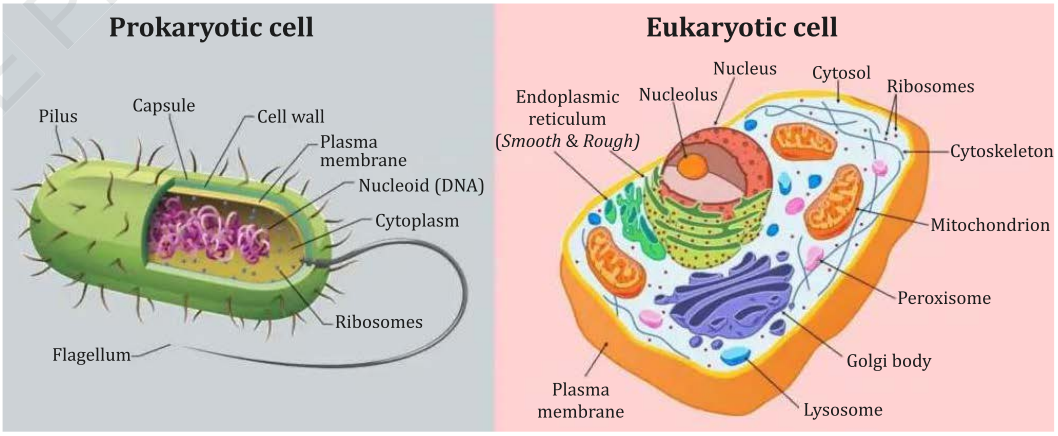
❑ BIOLOGICAL CLASSIFICATION SYSTEM

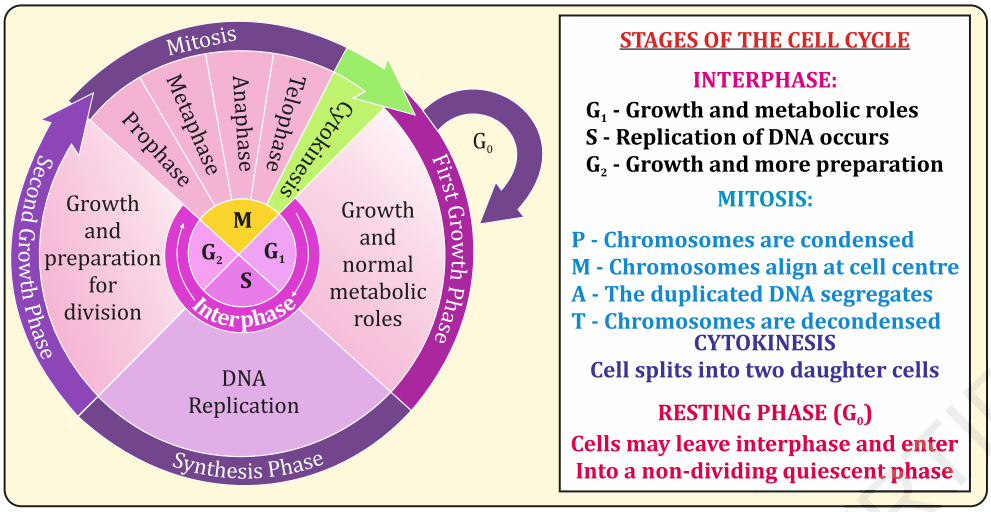


- **Binomial nomenclature** is related to **species and genus.**
- **Biological classification nomenclature** of drug is given according to **variety and species.**

Cell

- The two main types of cells are **prokaryotic cells, e.g. bacterial cells,** and **eukaryotic cells, e.g. animal and plant cells.** Prokaryotic cells are small, simple cells. Eukaryotic cells are larger and contain more complex cell organelles.





(I) Interphase (Non- dividing period)

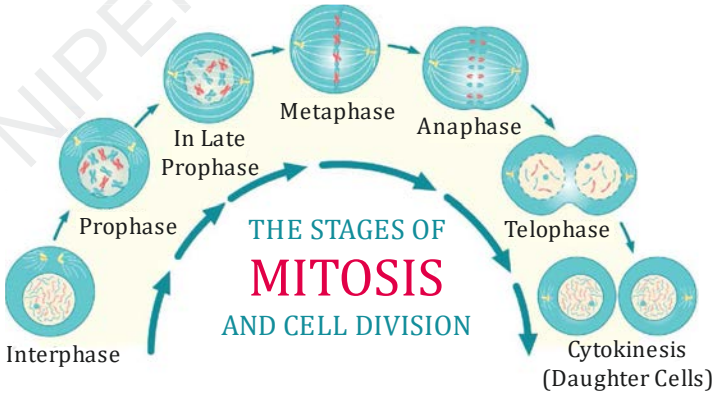
- Interphase is the phase in the **cell cycle** characterized by the **increased cell size** and **DNA replication in preparation for cell division.**

➢ **Interphase consists of three phases:** G_1, S, and G_2

First gap phase (G_1)	The **cell grows in size and volume**. This is usually the longest phase. Sometimes cells do not continue round the cell cycle but enter a **resting phase (G_0).**
Synthesis of DNA (S phase)	The chromosomes replicate, forming two identical copies of DNA. Therefore, the following S phase, the cell now has 92 chromosomes, enough DNA for two cells, and is nearly ready to divide by mitosis.
Second gap phase (G_2)	Cell growth continues, enzymes and other proteins are synthesized in preparation for cell division, and replication of centrosomes is completed.

(II) Mitosis (Period of division)

- Mitosis is the process by which a cell replicates its chromosomes and then segregates them, producing **two identical nuclei in preparation for cell division.**



➢ **Four distinct stages visible by light microscopy**

Prophase	• During this stage the replicated chromatin becomes tightly coiled and easier to see under the microscope • Each of the original **46 chromosomes** (called a chromatid at this stage) is paired with its copy in a double chromosome unit. • The two chromatids are joined to each other at the centromere
Metaphase	• The chromatids align on the **centre of the spindle**, attached by their **centromeres**

Digestive System

- Digestive system is made up of **gastrointestinal tract** (GI tract) or **alimentary canal** and **accessory organs**, which help in the process of **digestion** and **absorption**.

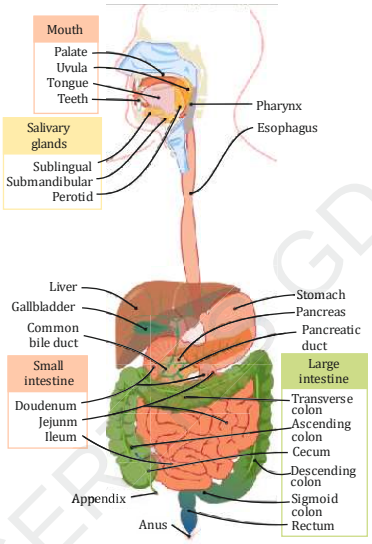


Fig:- Digestive system

❑ pH OF DIGESTIVE SYSTEM

IMPORTANT COMPARTMENTS	pH
Saliva (Mouth)	6.5-7.5
Upper Stomach (Fundic)	4.0-6.5
Lower Stomach	1.5 -4.0
Duodenum	7.0-8.5
Large Intestine	4.0-7.0
Gastric juice	2-4

❑ PART OF DIGESTIVE SYSTEM

PARTS OF DIGESTIVE SYSTEM	
Alimentary canal (GI tract)	The walls of the alimentary tract are formed by four layers of tissue: Adventitia (serosa), Muscle layer, Sub mucosa, Mucosa.
Buccopharyngeal cavity	The space between the jaws is divided into three parts- Buccal cavity, pharynx, vestibule.
Pharynx	• It is fibromuscular tube where trachea (windpipe) & oesophagus have its opening. • It serves as common passage for food and air.
Oesophagus (Food pipe)	• Long, narrow, muscular tubular structure which connects pharynx with stomach. • Oesophagus serves to convey food by peristalsis from pharynx to stomach.
Stomach	• Widest and distensible J-shaped part, placed obliquely behind diaphragm. • It is differentiated into 3 parts- cardiac, fundic & pyloric.
Pancreas	Pancreas contain two different kind of glandular tissue an **exocrine part** (secretes pancreatic juice) and **endocrine part** (secretes hormones -insulin and glucagon).
Liver	• Liver is organ with both secretory and excretory function. • Liver is made up of many lobes called hepatic lobes. • **Hepatic lobule** is the **structural and functional unit of liver**. • Liver lobules are arranged in pairs of columns radiating from central vein. • Between two pairs of columns of cells are sinusoids. • Amongst the cells lining the sinusoids are **hepatic macrophages (Kupffer cells)** whose function is to ingest and destroy worn out blood cells and any foreign particles present in blood flowing through liver.
Gall bladder	• Pear shaped yellow green like structure leis on inferior surface of right lobe. • **Gall bladder** stores **bile,** which is secreted by liver cells and collected by bile capillaries.
Small intestine	• Divided into three parts: ✓ **Proximal duodenum** (shortest and wider part) ✓ **Middle jejunum** (thicker and vascular) ✓ **Distal ileum** (thinner than jejunum and less vascular) • The first part of duodenum contains some mucus glands, which are called **Brunner glands.**

❑ EYES OR OPHTHALMOCEPTION

- The organs of sight are a pair of eyes in human.
- The **eyeball** is situated in a **bony cavity** known as **orbital cavity** or **eye socket**.

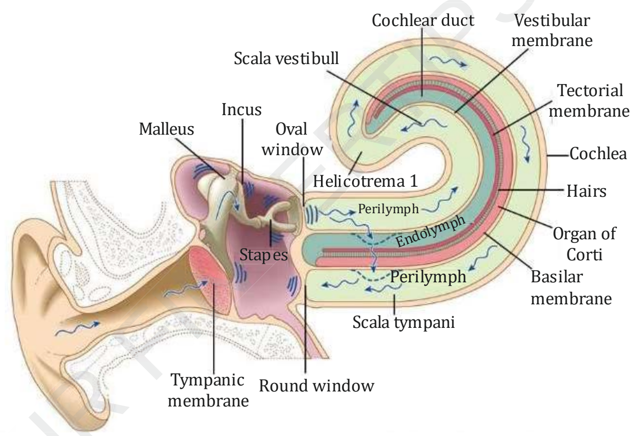
➢ Eye consists of tissues present in three concentric layers:

i. **Outermost** fibrous layer consists of **sclera** and **cornea.**
ii. **Middle vascular** layer consists of **choroid, ciliary body** and **iris**.
iii. **Innermost** nervous layer consists of **retina.**

- The **thinnest skin** is **conjunctiva** (eyelid).

❑ EARS-HEARING OR AUDIOCEPTION

Ears perform two sensory functions, **hearing and maintenance** of **body balance**.

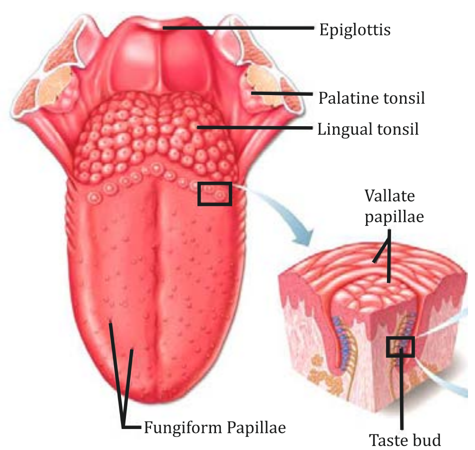


➢ Divided into three Parts:

i. **Outer ear:** It comprises two parts, pinna and external auditory canal.
ii. **Middle ear:** An air-filled cavity in the temporal bone that opens via the auditory (Eustachian) tube into the nasopharynx.
   - Middle ear contains flexible chain of three small bones called ear ossicles malleus, incus, stapes.
   - The stapes or stirrup is a bone smallest bone of the human body.
   - The tympanic membrane is also called the eardrum.

iii. **Inner ear:** A delicate, irregular organ called membranous labyrinth. It is surrounded by an almost similarly shaped bony labyrinth.
   Resting on the basilar membrane is the spiral organ or **organ of Corti.**

❑ TONGUE-TASTE OR GUSTAOCEPTION



(a) Taste buds associated with fungiform and vallate papillae **(b) Enlarged section of a vallate papilla**

- The sense organs for taste or gustatory sensation are the taste buds.
- Most taste buds are present in **papillae** of tongue, they are also situated in **mucosa of epiglottis** and **proximal part of esophagus**.

➢ Structure of Taste Buds

- The taste bud is the bundle of taste receptor cells, with supporting cells embedded in the **epithelial covering of the papillae.**

- **The cells of taste buds are divided into four groups:**

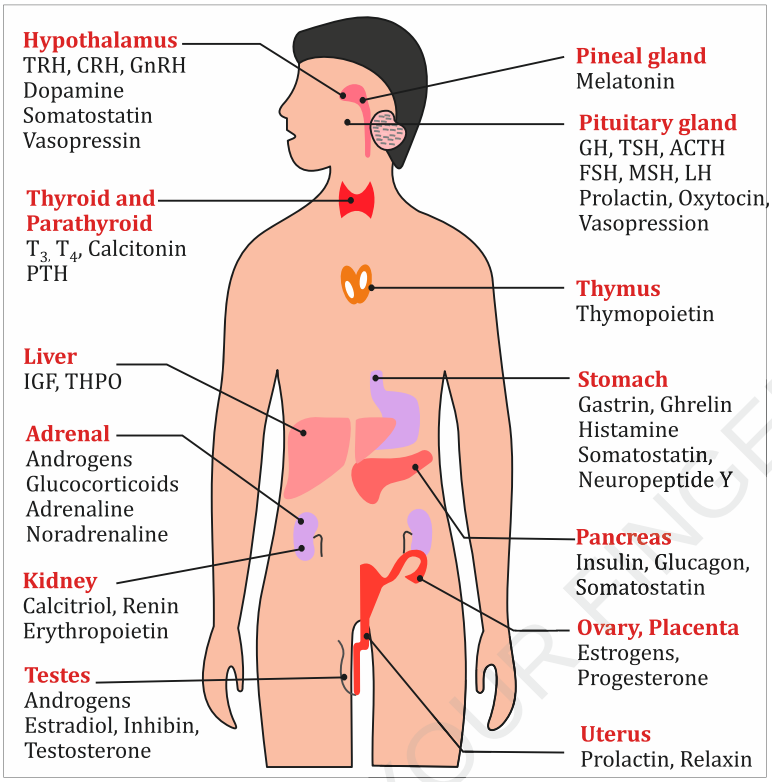
1. Type I cells (Sustentacular cells)
2. Type II cells
3. Type III cells
4. Type IV cells (Basal cells)

❑ NOSE-SMELL OR OLFALCOCEPTION

- The receptors for sense of smell (olfaction) are located in the olfactory epithelium of the nose.

ABNORMALITIES OF OLFACTORY SENSATION	
Anosmia	Total loss of sensation of smell
Hyposmia	Reduced ability to recognize and to detect any odor
Hyperosmia	Increased or exaggerated olfactory sensation

Endocrine System



❑ CLASSIFICATION OF HORMONE

CLASSIFICATION OF HORMONES	EXAMPLES
Amino acid derivative hormone	**Epinephrine** (Adrenaline), **Norepinephrine** (Noradrenaline) and **Thyroxine**
Peptide hormone	**Oxytocin** and **Vasopressin,** Hypothalamus regulatory hormones, Pituitary hormones, Glucagon, Parathyroid hormone insulin
Protein (Polypeptide) hormone	Somatotropic, Thyrotropic and Gonadotropic hormones, Insulin, Glucagon, Parathormone, Human Chorionic Gonadotropin (HCG), Human chorionic somatomammotropin and Relaxin
Steroid hormone	The hormones secreted by the **adrenal cortex, testes** and **ovaries** are composed of steroids. Placental estradiol and progesterone are also steroid hormones. Adrenocortical hormones, Sex steroids
Catecholamines	Adrenaline, Noradrenaline
Others	Triiodothyronine (T_3), Thyroxine (T_4)

❑ HORMONES, FUNCTION AND THEIR DISORDER

S.NO.	HORMONES	FUNCTIONS	DISORDERS
HORMONES FROM ANTERIOR LOBE (ADENOHYPOPHYSIS) OF PITUITARY			
1.	**Growth hormone (GH) or somatotropic hormone (STH)**	Stimulate growth by stimulating protein synthesis	• **In hypersecretion** → Gigantism • **Hypersecretion in adults** → Acromegaly • **Deficiency** → Dwarfism

Biochemistry

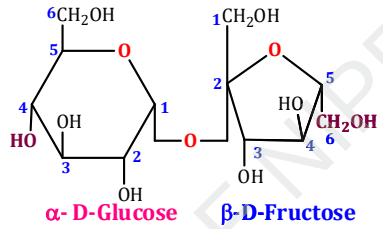
Carbohydrates

❒ CLASSIFICATIO OF CARBOHYDRATES

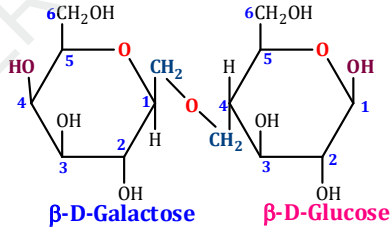
CLASSIFICATION	TYPES	EXAMPLE
MONOSACCHARIDES	**Triose ($C_3H_6O_3$)**	Glyceraldehyde, Dihydroxyacetone
	Tetrose ($C_4H_8O_4$)	Erythrose, Erythrulose
	Pentose ($C_5H_{10}O_5$)	Ribose, Ribulose, Deoxyribose, **Xylose,** Xylulose
	Hexose ($C_6H_{12}O_6$)	Glucose, Galactose, Mannose, Fructose
	Heptose ($C_7H_{14}O_7$)	D-Sedoheptulose
OLIGOSACCHARIDES	**Disaccharides**	Sucrose, Lactose, Maltose
	Trisaccharides	Raffinose, Gentianose
POLYSACCHARIDES	**Homopolysaccharide**	Starch, Dextrin, Inulin, Glycogen, Cellulose
	Heteropolysaccharides	Hyaluronic acid, Chondroitin, Heparin, Keratan sulphate, Dermatan sulphate.

❒ STRUCTURE OF IMPORTANT CARBOHYDRATES

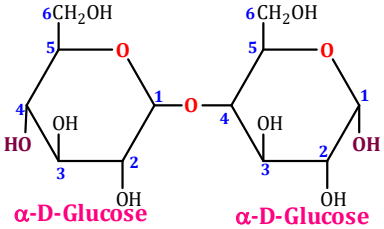
SUCROSE



LACTOSE

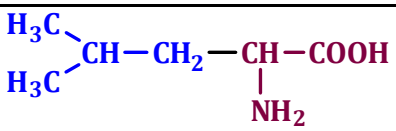
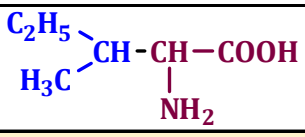
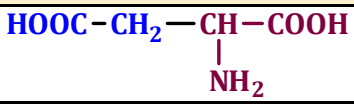
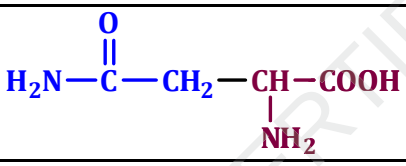
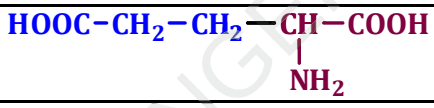
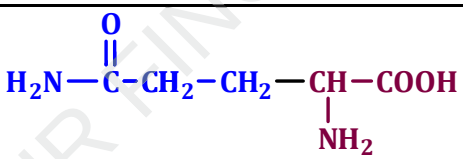
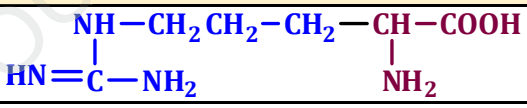
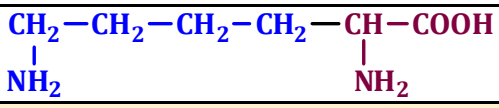
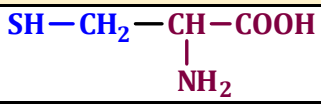
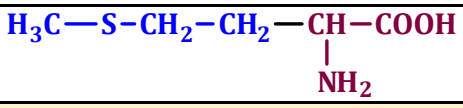
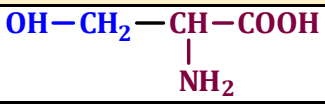
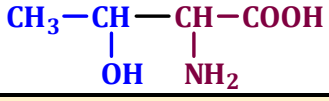
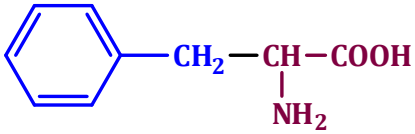
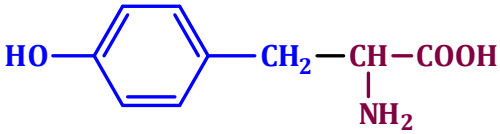


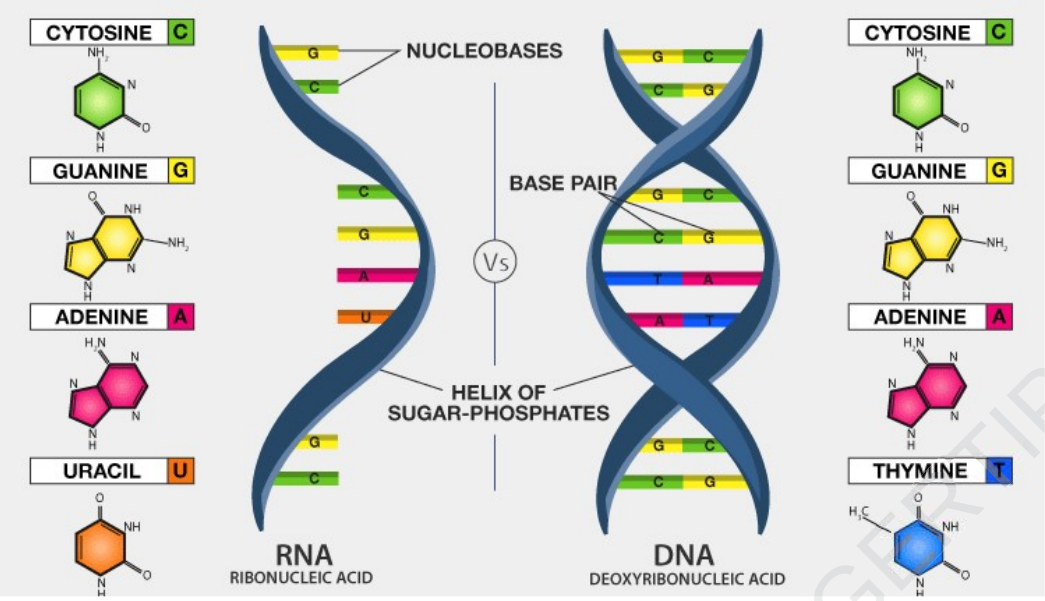
MALTOSE



❒ ISOMERISM IN MONOSACCHARIDES

ISOMERISM SHOWN IN MONOSACCHARIDES	
Epimers	• Two monosaccharides **differ from each other** in their configuration around a **single specific carbon glucose and galactose carbon 4 (C_4-epimers). They differ in the arrangement of OH group at C_4.** • Glucose – Epimer at C_2 – Mannose and Epimer at C_4 – Galactose
Anomers	• The **α and β cyclic forms of D-glucose.**
Mutarotation	• Change in the specific optical rotation → **α and β forms of D-glucose** to an equilibrium mixture.
Enantiomer	• **Mirror image** of each other **(D-Glucose & L-Glucose)** • 4 Asymmetric carbons so, 16 isomer • 2 Enantiomer and 14 - Diastereomers

4.	Leucine	Leu(L)	
5.	Isoleucine	Ile(I)	
SIDE CHAIN CONTAINING ACIDIC GROUP			
6.	Aspartic acid	Asp(D)	
7.	Asparagine	Asn(N)	
8.	Glutamic acid	Glu(E)	
9.	Glutamine	Gln(Q)	
SIDE CHAIN CONTAINING BASIC GROUP			
10.	Arginine	Arg(R)	
11.	Lysine	Lys(K)	
SULPHUR CONTAINING SIDE CHAIN			
12.	Cysteine	Cys(C)	
13.	Methionine	Met(M)	
SIDE CHAIN CONTAINING HYDROXYL GROUP			
14.	Serine	Ser(S)	
15.	Threonine	Thr(T)	
SIDE CHAIN CONTAINING AROMATIC GROUP			
16.	Phenylalanine	Phe(F)	
17.	Tyrosine	Tyr(Y)	



❖ RNA (Ribonucleic acid)

- Polymer of ribonucleotide held by 3', 5' -phosphodiester bridges.

✓ **Structure:**

- **Pentose:** Sugar in RNA is ribose.
- **Pyrimidine:** RNA contains pyrimidine, uracil in place of thymine (in DNA).
- **Single strand:** RNA is usually Single stranded polynucleotide.
- Chargaff's Rule not obeyed.
- RNAs can be histologically identified by Orcinol color reaction due to ribose.

✓ **Codon**

- Sequence of 3 bases in m-RNA molecule (triplet)
- 4 bases in DNA (Adenine, Guanine, Thymine, Cytosine)
- 64 triplet codons are possible
- Initiation codon:

✓ **AUG** =in AUG urates protein synthesis–Stopping codons:
✓ **UGA**=**U** **G**o **A**way
✓ **UAA**=**U** **A**re **A**way **UAG** = **U** **A**re **G**one

✓ RNA Polymerases:

Types of RNA Polymerase	Used for synthesis of
RNA Polymerase 1	r-RNA
RNA Polymerase 2	m-RNA
RNA Polymerase 3	t-RNA

❒ DIFFERENCE BETWEEN DNA AND RNA CHARACTERISTICS

CHARACTERISTICS	DNA	RNA
Present in	In chromosome & little in mitochondria & chloroplast.	Mostly in cytoplasm also in nucleus and ribosome.
Strands	Double (3'→5').	Single (5' →3').
Sugar	Deoxyribose sugar.	Ribose sugar.
Nitrogenous base	A, G, C & T	A, G, C, & U
Transcription	DNA→ DNA (replication). DNA→RNA (transcription).	RNA dose not replicate.

Biotechnology

Introduction of Biotechnology

INTRODUCTION

- Biotechnology is a branch of biology which deals with the techniques of using of **live organisms, enzymes or biological process** to generate products and services useful to human beings.

HISTORY OF BIOTECHNOLOGY

NAME OF SCIENTIST	YEAR	DISCOVERIES
Robert Hooke	1665	Cell
Robert Brown	1833	Nucleus (Plant cell)
Johann Friedrich	1869	DNA
Albrecht Kossel	1879	Nucleic acid
Edouard Van Beneden	1882	Specific no. of chromosomes
Wilhelm Johannsen	1909	Gene
Oswald Avery	1944	Genetic information
Watson and Crick	1953	DNA structure
Marshall Nirenberg	1964	Genetic code
Boyer and Cohen	1973	Recombinant DNA technology
Kohler and Milstein	1975	Product of monoclonal antibodies
Yuet Wai Kan	1976	Sickle cell anemia
William J. Rutter	1987	Genetically engineered vaccine against hepatitis B

Plant and Tissue Culture

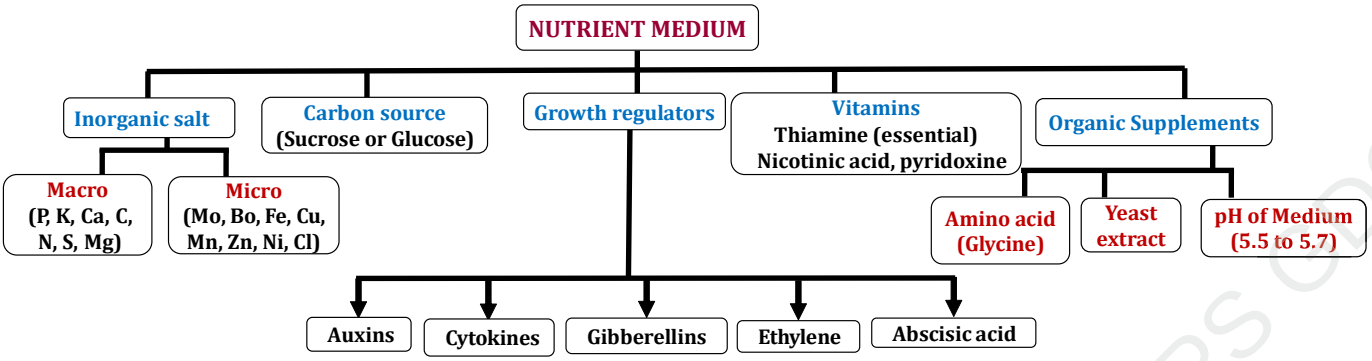
INTRODUCTION

- Plant tissue culture is a collection of techniques used to maintain or grow plant cell or tissue or organ under sterile condition on **nutrient culture medium.**
- The **father of plant tissue culture** is **Gottlieb Haberlandt.**

TERMINOLOGY

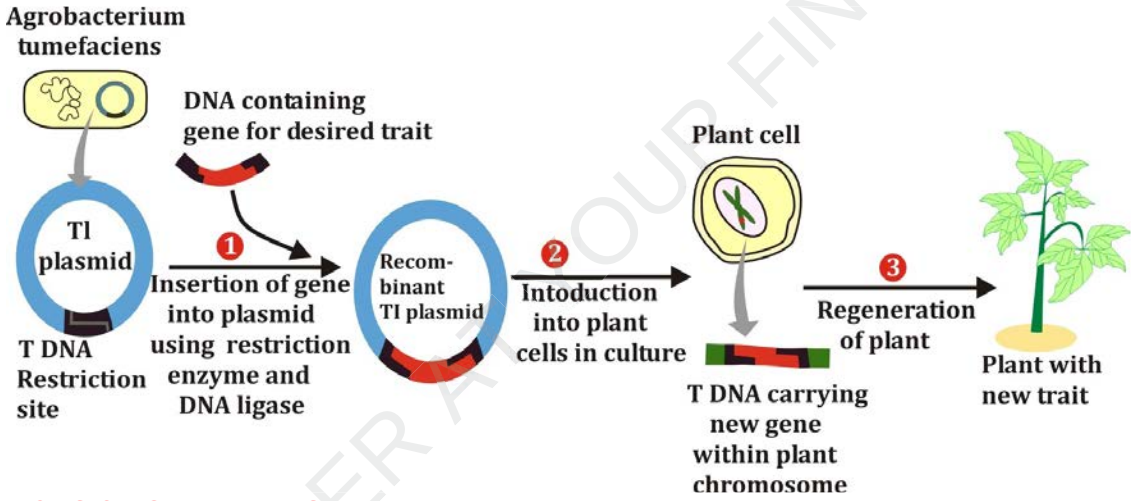
S. NO.	TERMINOLOGY	DEFINITION
1	Totipotency	It is an **ability of plant cell to generate** into whole plant.
2	Explant	An excised piece of **differentiated tissue or organ** is regarded as explant and it may be part of plant, e.g.- **Leaf, stem and root.**
3	Callus	The unorganized and undiffererrtiated mass of plant cells is referred to as callus. When plant cells are cultured in a suitable medium, they divide to form callus.

❑ PLANT TISSUE CULTURE MEDIA

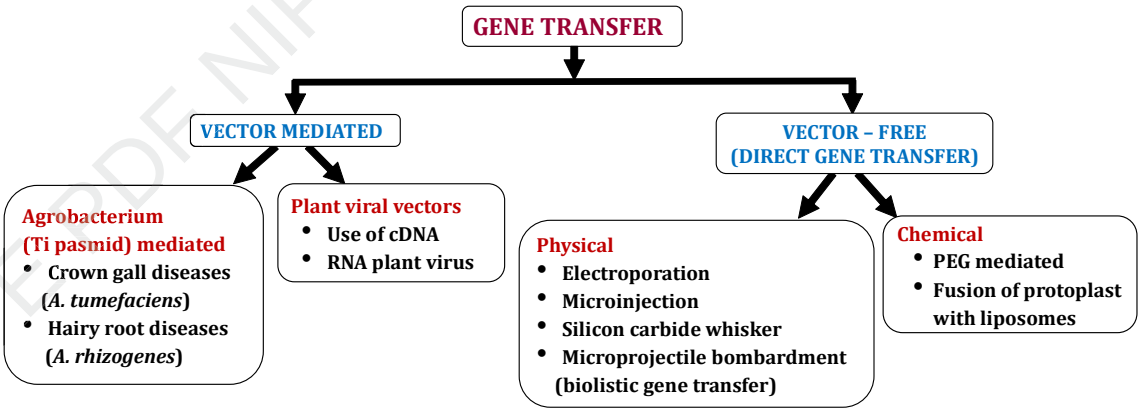


❑ TRANSGENIC PLANTS

- The Plant or animal, whose genome is after by adding one or more transgene are known as **transgenic plants** or transgenic animals. The genetically transformed new plants are regarded as transgenic plants.
- Transgenic plants are the ones, whose DNA is modified using genetic engineering techniques.
- In **1982**, the first transgenic plants were produced in **tobacco plants** (*Nicotiana tabacum*) which expressed antibiotic resistance.



❑ METHODS OF GENE TRANSFER



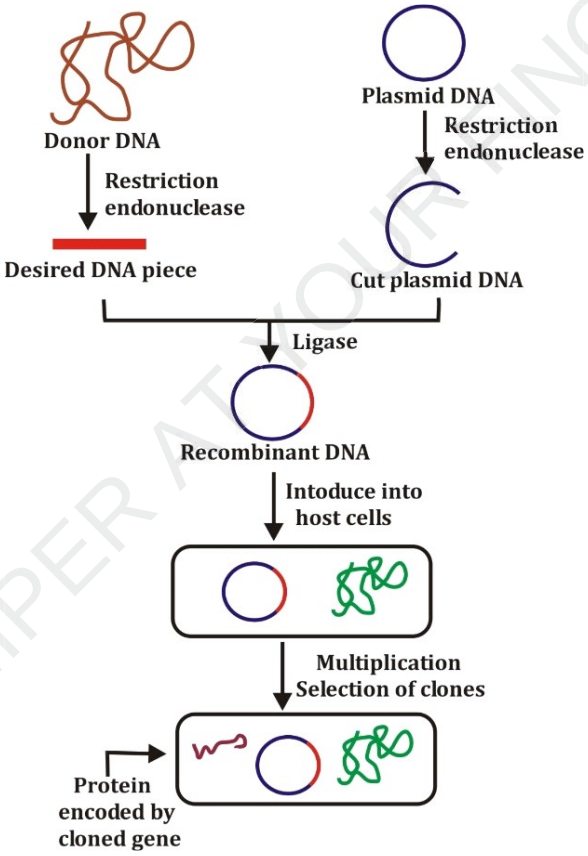
METHOD	SALIENT FEATURE
Vector-mediated gene transfer	
Agrobacterium (Ti plasmid)-mediated gene transfer Plant viral vector	• *Agrobacterium tumefaciens* is a soil-borne, Gram-negative bacterium. • Very efficient, but limited to a selected group of plants Ineffective method, hence not widely used.

Recombinant DNA Technology

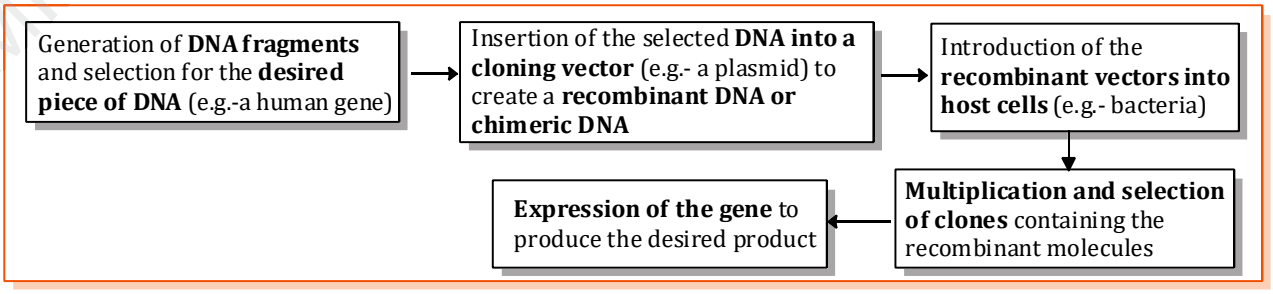
❑ TERMINOLOGY

TERMS	DESCRIPTION
Recombinant DNA technology	Recombinant DNA technology is the techniques involved in the **construction,** and use of **recombinant DNA molecule.**
Genetic Engineering	Genetic engineering primarily involves the **manipulation of genetic material (DNA)** to achieve the desired goal in a pre-determined way. Some other terms are also in common use to describe genetic engineering.
Genomic Library	Genomic library is **collection of the total Genomic DNA** fragments from a particular species represents gene libraries.
Gene Therapy	Gene therapy is the process of **inserting genes into cells to treat diseases.**

❑ PRINCIPLE OF RECOMBINANT DNA TECHNOLOGY



❖ BASIC PRINCIPLES OF rDNA TECHNOLOGY

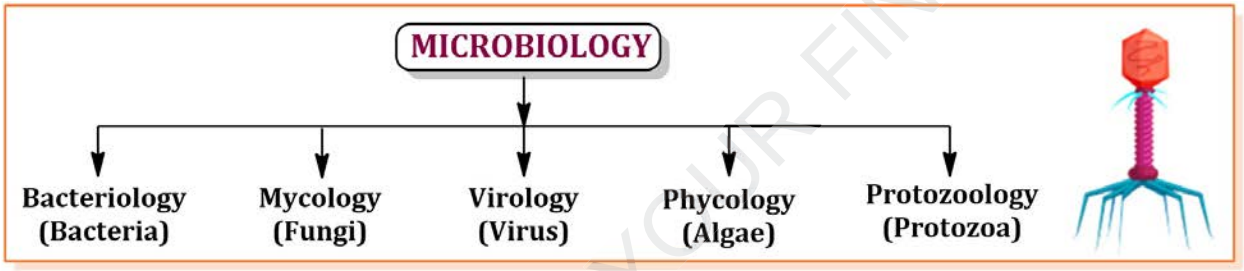


Microbiology

Introduction and History of Microbiology

❑ INTRODUCTION

- Microbiology is the **study of microorganisms** that is the organism which are of **microscopic dimensions.**
- At present there is general agreement to include five major groups as microorganisms. The subdivisions are-

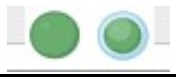
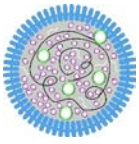


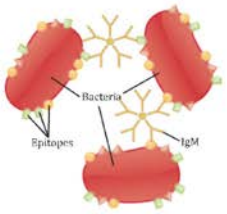
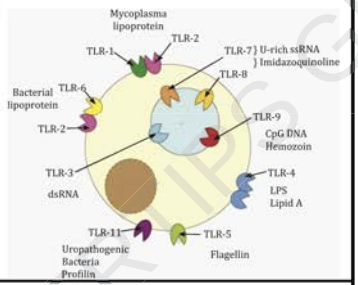
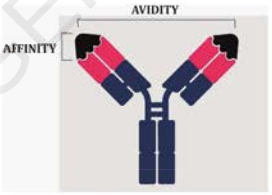
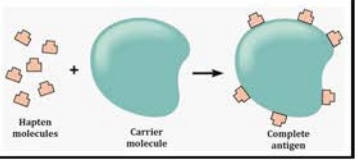
❑ IMPORTANT CONTRIBUTIONS OF SCIENTISTS IN MICROBIOLOGY

SCIENTIST	CONTRIBUTIONS
Robert Hooke 	• **Hooke studied plant sections and saw matrix of tiny cylindrical-like structures he called cells**. • He published famous book called **Micrographia**, which has sketches of various natural things under a microscope.
Antonie van Leeuwenhoek 	• Published Letters by **Royal Society in London,** Leeuwenhoek **described 'Animalcules'.** • He called bacteria as "animalcules" or "little animals" • Known as **'Father of microscopy and microbiology'** as he proves life in cell by observing their motility. • Only microbes not described by Leeuwenhoek **were viruses.**
Carl Linnaeus 	• Proposed first universal **classification system of living beings.** • He created system of naming plants and animals. • Known as the 'Father of modern taxonomy'.
Louis Pasteur 	• He proposed that **microbes** were responsible for illnesses. • Resolved the controversy of spontaneous generation versus biogenesis. • He discovered pasteurization, fermentation process. • He also discovered vaccine for **rabies** and **anthrax**.

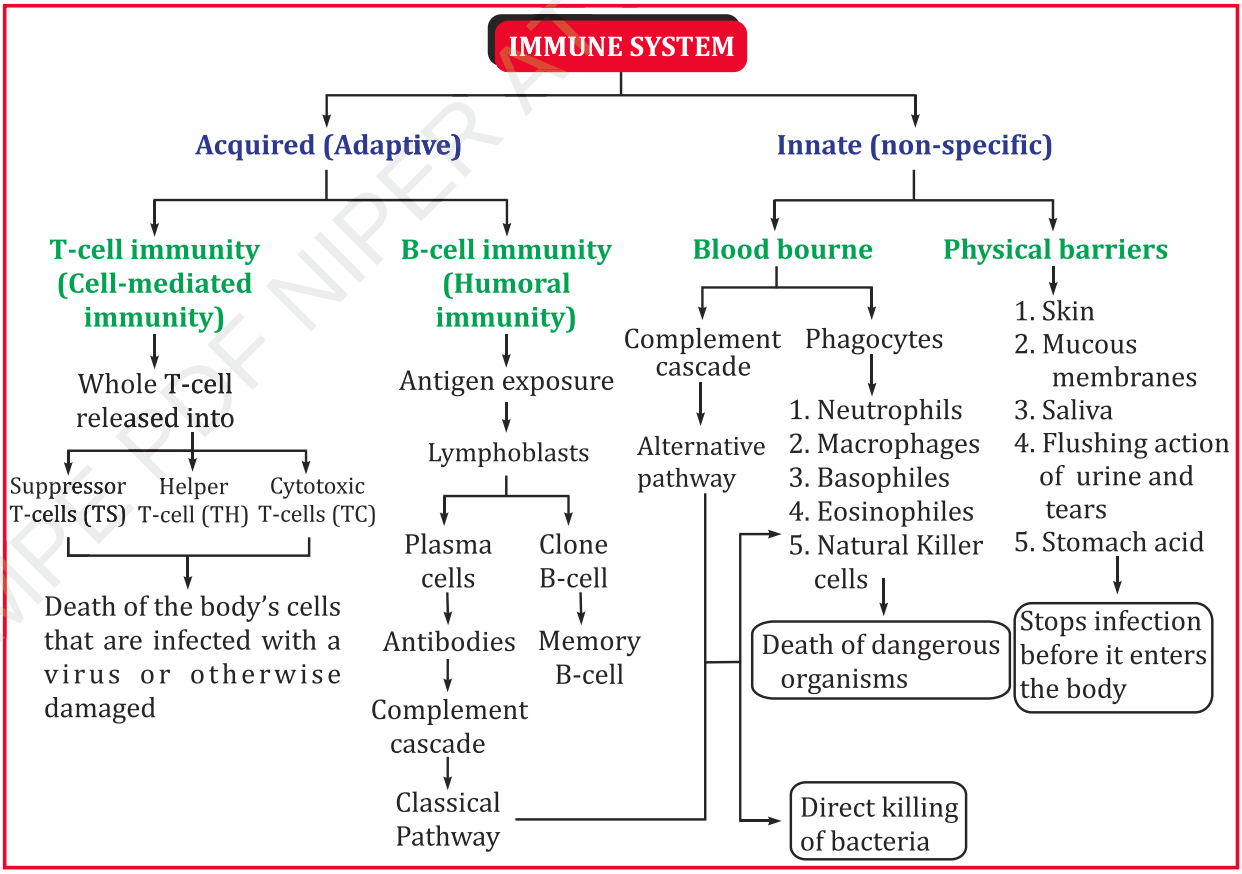
❑ CLASSIFICATION OF BACTERIA

1. CLASSIFICATION ON THE BASIS OF MORPHOLOGICAL STRUCTURE

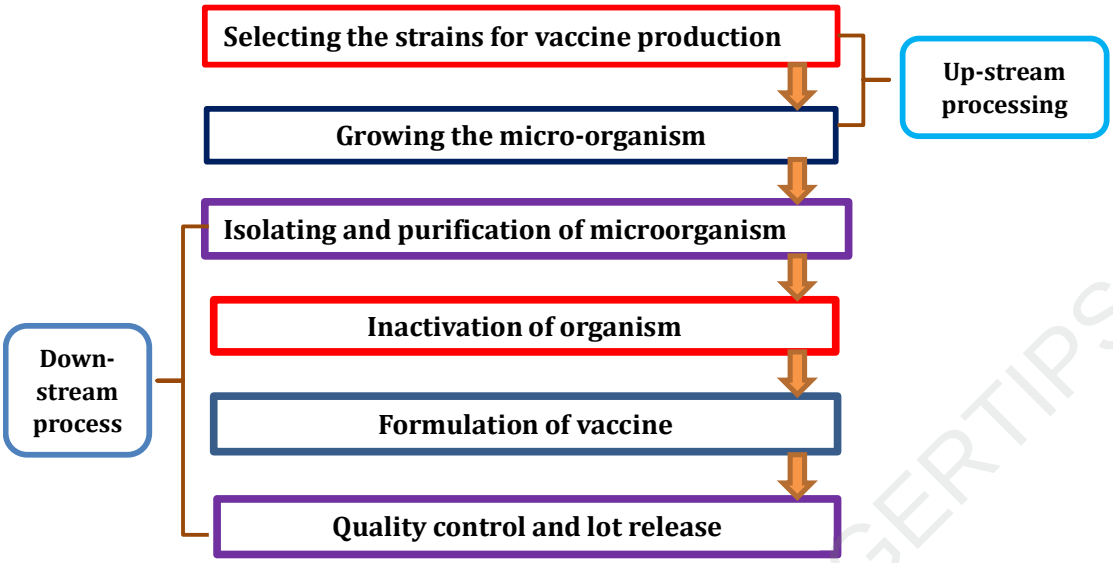
S.NO.	TYPES	BACTERIA	ARRANGEMENT	STRUCTURE	EXAMPLE
1	SPHERICAL (COCCI) (0.8 to 1.0 µm)	**Micrococci**	Occur singly		***Micrococcus***
		Diplococci	Two cell joints together		***Streptococcus pneumoniae***
		Streptococci	Divided in one plane & forms chain like structure		***Streptococcus pyogenes, Streptococcus lactis***
		Tetracoccci	In group of four		***Gaffkya tetragena***
		Staphylococci	Grapes like cluster arrangement		***Staphylococcus aureus***
		Sarcina	Arrangement of group of eight cell		***Sarcina ventriculi***
2	CYLINDRICAL OR ROD SHAPE (BACILLUS) (0.75 to 10 µm length and 0.75 to 3 µm diameter)	**Bacillus**	Single cells		***Bacillus cereus, Salmonella chole -raesuis***
		Diplobacillus	Pair of bacilli		***Coxiella burnetii, Klebsiella***
		Streptobacillus	Chain of bacilli		***Bacillus anthracis***
3	CURVED/ SPIRAL	**Spirochetes**	Spiral shape		***Treponema pallidum***
		Vibrio	Comma shape, curved rod		***Vibrio cholerae***
		Spirilla	Longer rigid rod with several curve coil. (S shaped)		***Spirillum rupae, Helicobacter pylori***
4	PALISADE	**Corynebacterium**	Palisade arrangement		***Corynebacterium diphtheria***
5	MOLD LIKE	**Streptomycetes**	Mold like filament		***Streptomycetes griseus,*** **Aspergillus**
6	ACTINOMYCETES		Branching filamentous bacteria		***Streptomyces species***
7	MYCOPLASMAS		Do not having stable morphology		***Mycoplasma haemofelis***

Agglutination	The aggregation of **bacterial cells** into agglutinates enabling **phagocytes** to eliminate these cells rapidly from the body.	
Adjuvant	Substance that improves immune response to a particular antigen when administered with vaccines.	
Affinity	Binding potential of a single variable region of an antibody for a corresponding epitope o the larger antigen moiety.	
Hapten	Antigenic i.e. have capacity to bind with antibody but not immunogenic.	

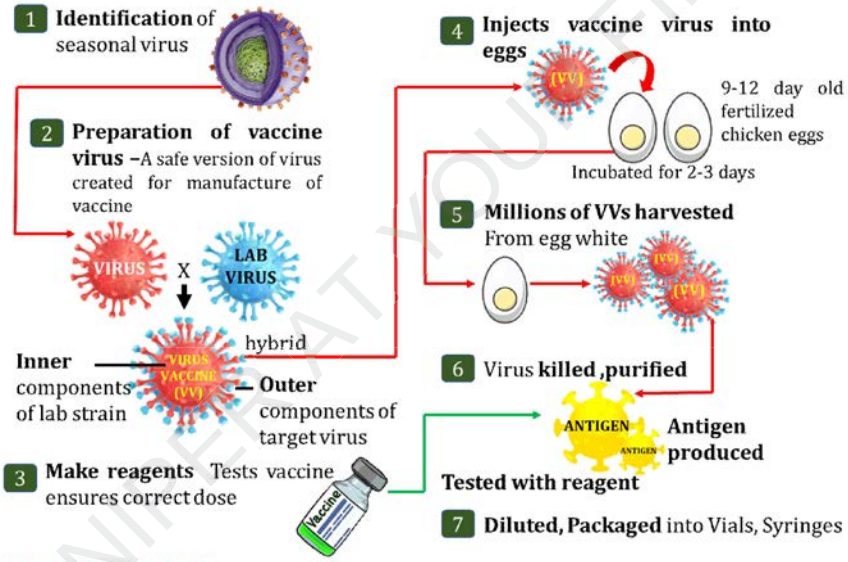
❑ IMMUNE SYSTEM



❑ STEPS IN VACCINE PREPARATION



❑ VACCINE PREPARATION FROM EMBRYONATED EGG



❑ VACCINES USED IN DISEASES

VACCINE	ROUTE	DISEASE	SOURCE
DPT (Diphtheria, Pertussis, Tetanus)	Intramuscular	Diphtheria, Whooping cough	*Corynebacterium diphtheriae, Bordetella pertussis*
Influenza vaccine	Subcutaneous	Influenza	Influenza virus
Varicella zoster Immunoglobulin	Intramuscular	Chicken pox	*Varicella zoster*
BCG	Intradermal	Tuberculosis	*Mycobacterium tuberculosis*
OPV (Oral PolioVaccine)	Oral	Poliomyelitis	Polio virus
Hepatitis B	Oral	Hepatitis	Hepatitis B virus
Cholera vaccine	Subcutaneous	Cholera	*Vibrio cholerae*
TAB vaccine	Subcutaneous	Typhoid	*Salmonella typhi*
Tetanus vaccine	Intramuscular	Tetanus	*Clostridium tetani*
Small pox	Subcutaneous	Small pox	*Variola, Vaccinia* virus
Rabies	Intramuscular	Rabies	Rabies virus
Measles	Subcutaneous	Measles	Mumps virus

Pharmaceutical Management

Introduction to Management

❑ PHARMACEUTICAL MANAGEMENT

When the principle and practices of management are applied to pharmaceutical industry and drug store, it is known as **"Pharmaceutical Management".**

The process of conducting and managing various business activities.

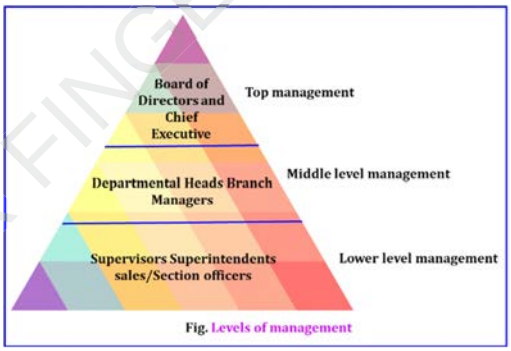


Fig. Levels of management

I. **Top level management -** It is the ultimate source of authority which frame the policies for the enterprise.
II. **Middle-level management -** They are responsible to the top management for the efficient functioning of their department.
III. **Lower-level management -** They issue orders and instructions and guide day to day activities.

❑ Levels of Management Function

Fig. Showing the function of management

I. **Planning -** It is an intellectual or mental exercise requiring imagination and judgmental.
II. **Organizing -** Means a group of people contributing their efforts towards the attainment of certain common objectives.
III. **Staffing -** The various activities such as selection, communication, participation, counselling, training, compensation, dismissal etc. comes under it.
IV. **Directing -** Involves issuing orders and instructions, motivating and leading subordinates, harmonizing organizational goals with in terest of employees.
V. **Controlling -** Means the steps taken to ensure that the performance of the organization conforms to the plans.
VI. **Coordinating -** Laid down which can ultimately be fulfilled only by coordination among its various departments.

❖ Principles of Management

TYPES	DESCRIPTION
Division of Work	Employee is given a specific task to do.
Authority	Necessary authority in order to ensure that his instructions are carried out by the employees.
Discipline	Disciplined employees, managers need to build a culture of mutual respect.
Unity of Command	Employee should receive orders from only one manager.

Pharma and Non-Pharma Thrust Area

USFDA Approved Drugs-2024

S. NO.	DRUG NAME	ACTIVE INGREDIENT	APPROVAL DATE	FDA APPROVED USE ON APPROVAL DATE
1	Zelsuvmi	Berdazimer	05/Jan/2024	To treat molluscum contagiosum
2.	Exblifep	Cefepime, Enmetazobactam	22/Feb/2024	To treat complicated urinary tract infections
3.	Letybo	Letibotulinumtoxina-Wlbg	29/ Feb /2024	To temporarily improve the appearance of moderate-to-severe glabellar lines
4.	Tevimbra	Tislelizumab-Jsgr	13/March/2024	To treat unresectable or metastatic esophageal squamous cell carcinoma
5.	Rezdiffra	Resmetirom	14/ March/2024	To treat noncirrhotic non-alcoholic steatohepatitis with moderate to advanced liver scarring
6.	Tryvio	Aprocitentan	19/March/2024	To treat hypertension
7.	Duvyzat	Givinostat	21/ March/2024	To treat Duchenne muscular dystrophy in individuals aged 6 years and older
8.	Winrevair	Sotatercept-Osrk	26/ March/2024	To treat pulmonary arterial hypertension
9.	Vafseo	Vadadustat	27/ March/2024	To treat anemia due to chronic kidney disease
10.	Voydeya	Danicopan	29/ March/2024	To treat extravascular hemolysis with paroxysmal nocturnal hemoglobinuria
11.	Zevtera	Ceftobiprole Medocaril Sodium	03/ April/2024	To treat certain bloodstream infections, bacterial skin and associated tissue infections, and community-acquired bacterial pneumonia
12.	Lumisight	Pegulicianine	17/ April/2024	To use as an optical imaging agent for the detection of cancerous tissue
13.	Anktiva	Nogapendekin Alfa Inbakicept-Pmin	22/April/2024	To treat bladder cancer
14.	Ojemda	Tovorafenib	23/April/2024	To treat relapsed or refractory pediatric low-grade glioma
15.	Xolremdi	Mavorixafor	26/ April/2024	To treat WHIM syndrome (warts, hypogammaglobulinemia, infections and myelokathexis)

Nobel Prize and Laureates-2024

FIELD	NOBEL LAUREATES	CONTRIBUTION
Physics	Geoffrey Hinton, John Hopfield	Foundational contributions to artificial intelligence, especially in neural networks.
Chemistry	Demis Hassabis, John Jumper, David Baker	Innovations in protein structure prediction, including the development of AlphaFold2.
Physiology or Medicine	Victor Ambros, Gary Ruvkun	Discovery of microRNA and its role in gene regulation.
Literature	Han Kang	Intense poetic prose confronting human fragility and historical traumas.
Peace	Nihon Hidankyo (Japan Confederation of A- and H-Bomb Sufferers Organizations)	Advocacy for a nuclear weapon-free world, led by survivors of Hiroshima and Nagasaki.
Economic Sciences	Daron Acemoglu, Simon Johnson, James Robinson	Research on how political institutions impact economic development.

Multiple Nobel Laureates Till 2024

NOBEL LAUREATE	FIELDS	YEARS OF NOBEL PRIZES	ACHIEVEMENT
Marie Curie	Physics, Chemistry	1903 (Physics), 1911 (Chemistry)	First woman to win the Nobel Prize. Her work on radiation and the discovery of radium and polonium.
Linus Pauling	Chemistry, Peace	1954 (Chemistry), 1962 (Peace)	Awarded for his work on chemical bonding and his anti-nuclear activism, being the only person with two unshared prizes.
John Bardeen	Physics	1956 (Physics), 1972 (Physics)	Twice awarded for his work on transistors and the theory of superconductivity.
Frederick Sanger	Chemistry	1958 (Chemistry), 1980 (Chemistry)	Won for his work on protein structure and DNA sequencing.
International Committee of the Red Cross (ICRC)	Peace	1917, 1944, 1963, 1965, 1973, 1993	Awarded multiple times for its humanitarian efforts during wars and crises.
United Nations	Peace	1965, 1974, 1988, 2001	Recognized for its peacekeeping missions and efforts in conflict resolution and humanitarian work.

❑ IG NOBEL PRIZES FOR IMPROBABLE RESEARCH

- The Ig Noble Pirze is a **satiric prize awarded** annually since **1991** and awarded each year in **mid-September** to **celebrate ten unusual or trivial achievements** in scientific research.
- Its aim is to **"honor achievements that first make people laugh, and then make them think."**

The name of the award is a pun on the Nobel Prize, which it parodies, and on t he word ignoble ("not noble")

Gallantry Awards

❑ PEACE-TIME GALLANTRY AWARDS

Ashoka Chakra		The Ashoka Chakra is India's highest peacetime military decoration awarded for valour, courageous action or self-sacrifice away from the battlefield. It Was originally **established on 4 January 1952** as the **"Ashoka Chakra, Class I"** as the first step of a three-class sequence of non-combatant bravery decorations.
Shaurya Chakra		The Shaurya Chakra is an Indian military decoration awarded for valour, courageous action or self-sacrifice while not engaged in direct action with the enemy. **Established as the "Ashoka Chakra, Class III" by the President of India, 4 January 1952.** The statutes were revised and the decoration **renamed on 27 January 1967.**
Kirti Chakra		Established as the "Ashoka Chakra, Class II" by the President of India, **4 January 1952** (with effect from 15 August 1947). The statutes were revised and the decoration **renamed on 27 January 1967.**

❑ WAR-TIME GALLANTRY AWARDS

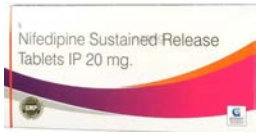
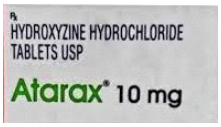
Param Vir Chakra		**India's highest military decoration, awarded for displaying distinguished acts of valour during wartime.** Param Vir Chakra translates as the **"Wheel of the Ultimate Brave",** and the award is granted for **"most conspicuous bravery in the presence of the enemy".**
Maha Vir Chakra		Second highest military decoration in India, **awarded for acts of conspicuous gallantry in the presence of the enemy, whether on land, at sea or in the air**. It replaced the British Distinguished Service Order (DSO).
Vir Chakra		Vir Chakra is an Indian gallantry award presented for acts of gallantry in the presence of the enemy on the battlefield. **Established by the President of India on 26 January 1950.** The statutes were amended 12 January 1952 to readjust the order of wearing as new decorations were established.

National Sports Awards in India

Major Dhyan Chand Sport Jewel Award, formerly known as the Rajiv Gandhi Khel Ratna Award in Sports and Games, is **the highest sporting honour of India**.		**Discipline(s)** **Chess, Billiards, Yachting, Weightlifting, Tennis, Gymnastics, Cricket, Athletics, Hockey, Badminton, Shooting, Athletics, Shooting Snooker, Shooting, Boxing, Wrestling, Paralympic high jump, etc.**
Arjuna Award		**Discipline(s)** **Archery, Athletics, Badminton, Basketball, Boxing, Cycling, Equestrian, Football, Golf, Gymnastics, Hockey, Judo, Lawn Tennis, Rowing, Shooting, Swimming, Table Tennis, Volleyball, Weightlifting, Winter Sports, Wrestling, etc.**
Dronacharya Award		**Discipline(s)** **Archery, Athletics, Badminton, Billiards & Snooker, Boxing, Chess, Cricket, Football, Gymnastics, Hockey, Kabaddi, Kho-kho, Mallakhamb, Powerlifting, Rowing, Shooting, Squash, Table Tennis, Weightlifting, Wrestling, Wushu, Yachting.**
Dhyan Chand Award		**Discipline(s)** **Boxing, Hockey, Basketball, Volleyball, Rowing, Athletics, Wrestling, Billiards & Snooker, Kabaddi, Weightlifting, Football, Swimming, Para-Sports, Tennis, Badminton,**

❑ LITERARY AWARDS IN INDIA

Jnanpith Award 	Oldest and the highest Indian literary award presented annually by the Bharatiya Jnanpith to an author for their "outstanding contribution towards literature". Instituted in 1961, the award is bestowed only on Indian writers writing in Indian languages included in the Eighth Schedule to the Constitution of India and English.

Warfarin	**Warf -5 Coumadin, and Jantoven.**	**Anticoagulants**	Warfarin reduces the formation of blood clots.	
Metoprolol Tablet	**Matrate Metorol**	**Cardiovascular drug**	Metoprolol is used to treat angina (chest pain) and hypertension (high blood pressure).	
Permethrin	**Perskin Scabus**	**Antifungal**	This medication is used to treat scabies.	
Amphotericin -B	**Amphodex**	**Antibiotic**	This medication is used to treat a variety of serious fungal infections.	
Propranolol Tablet	**Inderal Ciplar**	**Cardio-vascular drug**	Propranolol is used in the treatment of Hypertension (high blood pressure), Prevention of migraine.	
Diltiazem Tablet	**DTM – 30 Cardiil**	**Cardiovascular drug**	Diltiazem is used to treat hypertension (high blood pressure), angina (chest pain), and certain heart rhythm disorders.	
Calamine	**Caladryl Lacto calamine**	**Anti allergic**	used to treat mild itchiness. This includes from sunburn, insect bites, poison ivy, poison oak, or other mild skin conditions.	
Nifedipine	**Nepine Agifine Nifcard**	**Calcium channel blocker**	Used to treat high blood pressure (hypertension) & to prevent angina (heart-related chest pain).	
Digoxin	**Dixin Lanoxin**	**Cardio-vascular drug**	Used for the treatment of heart failure	
Nicrondil	**Nicovexx Nicosyd**	**Vasodilator**	Nicorandil is used in the treatment of Angina (heart-related chest pain)	
Hydroxyzine	**Atarax Hydrax**	**Antihistaminic**	Hydroxyzine is used to treat itching caused by allergies.	
Loratadine	**Loratin Lormac Lormeg**	**Antihistaminic**	Loratadine is used in the treatment of allergic conditions.	

V WASH	Hindustan Unilever Limited	Ammonium Lauryl Sulphate Water, Triethanolamine Lauryl Sulphate	V-Wash maintains the intimate area's pH while preventing itching, irritation and dryness.	
Kayam Churna	Sheth Brothers	Senna Leaves, Black Salt, Nishoth, Himej, Svarjika Kshara, and Jethi Madh	Constipation, acidity, headache and ulcers linked to constipation, and flatulence	
Zandu Pancharishta	ZYDUS Zydus Wellness	Draksa, Kumari, Dashmoola, Ashwagandha Satavari, Triphala, Yasti & Trikatu	Acts on the entire digestive system Helps to improve the immune system	
TULSI DROP	DABUR Dabur	Tulsi herbs	Control cholesterol level healthy liver functioning boost the immune system	
SAFI	Hamdard Laboratories India	Neem, Tulsi, Chob chini, Keekar, Brahmi, Kasni, Unnab, Revand Chini, Qand Safaid, and Shora	Remove impurities from blood achieve pimple and acne-free skin	
LAL TAIL	DABUR Dabur	Shankhapushpi, Ratanjot Til Tail (Sesame Oil), Camphor Urad	Baby to gain weight and improves his sleep quality	
Navratna Cool	EMAMI emami	Sesame oil, Menthol, Amla Camphor, Thyme, Rosemary oil	Improves the blood circulation & relaxes the muscles	
NYCIL	ZYDUS Zydus Wellness	Talcum, Fragrance, Anti-bacterial formula	Treats microbes causing skin problems like rashes due to prickly heat and prickly heat	
Odomos	DABUR Dabur	Aloe Vera, Citronella	Insect repellent	

Some Important Abbreviations

ABBREVIATIONS	FULL FORM
AAAS	American Association of Advancement of Science
AALAS	American Association for Laboratory Animal Science
AIDS	Acquired Immune Deficiency Syndrome
AIOPI	Association of Information Officers of the Pharmaceutical Industry
ALF	American Liberation Front
ANDA	Abbreviated New Drug Application
BEA	Breeding for Experimental Animals
BINAS	Biosafety Information Network and Advisory Service
BMJ	British Medical Journal
BPC	Bulk Pharmaceutical Chemicals
BPI	British Pharmaceutical Index
BrAPP	British Association of Pharmaceutical Physicians
BUAV	British Union for the Abolition of Vivisection
CADD	Computer Aided Drug Design
CDC	Centre for Disease Control
CIOMS	Council for International Organisations of Medical Sciences
CPCSEA	Committee for Purpose of Control & Supervision of Experimental Animals
CPI	Consumer Price Index
CRA	Clinical Research Associate
CRC	Clinical Research Council
CRF	Case Report Form
CRN	Clinical Research Network
CRO	Contract Research Organisation
CSM	Committee on Safety of Medicines
CTC	Clinical Trials Centre
CTD	Common Technical Document
CTD	Common Technical Document
DRA	Drug Regulatory Affairs
DUMP	Disposal of Unwanted Medicines and Poisons
EFPIA	European Federation of Pharmaceutical Industries & Associations
EMEA	European Medicine Agency
FDA	Food & Drug Administration
FIP	International Pharmaceutical Federations
GCP	Good Clinical Practices
GLP	Good Laboratory Practices
GMP	Good Manufacturing Practices
HIS	Indian Health Services
HPLC	High Performance Liquid Chromatography
HRSA	Health Resources & Service Administration
IACUC	Institutional Animal Care and Use Committee
IAES	Institutional Animal Ethics Committee
ICDRA	International Conference for Drug Regulatory Authorities
ICH	International Conference on Harmonization of technical requirement for registration of pharmaceuticals

Facts About The Corona Virus

❑ INTRODUCTION

❖ What is corona virus ?

Corona viruses are a large family of viruses which may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as **Middle East Respiratory Syndrome (MERS)** and **Severe Acute Respiratory Syndrome (SARS).** The most recently discovered coronavirus causes coronavirus disease **COVID-19.**

❖ What is a 'novel' coronavirus ?

- A novel coronavirus (CoV) is a new strain of coronavirus.
- The disease caused by the novel coronavirus first identified in Wuhan, China, ha been named **coronavirus disease 2019 (COVID-19) – 'CO' stands for corona, 'VI for virus, and 'D' for disease.**
- Formerly, this disease was referred to as **'2019 novel coronavirus' or '2019-nCoV.'**
- The COVID-19 virus is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) and some types of common cold.

❖ How does the COVID-19 virus spread ?

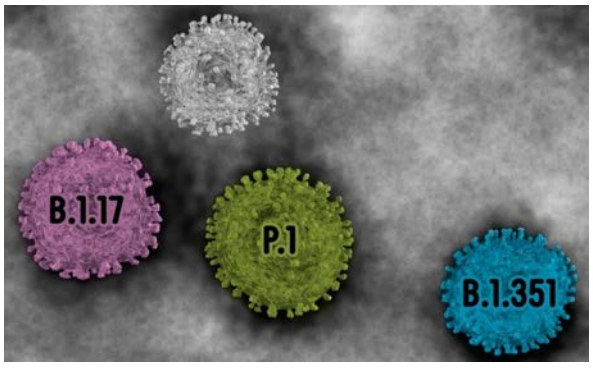
- The virus is transmitted through **direct contact with respiratory droplets of an infected person** (Generated through coughing and sneezing), and touching surfaces contaminated with the virus.
- The COVID-19 virus may survive on surfaces for several hours, but simple disinfectants can kill it.

❑ THE 3 MAJOR COVID-19 VARIANTS

The three major variants emerged at different times, and in different parts of the world. Here's an overview of each variant, when they were discovered, and how far they've spreadso far.

B.1.1.7

- The B.1.1.7 variant was **detected in the UK** in the fall of 2020. By December 2020, it had spread across the globe, with cases emerging across Europe, North America, and Asia.
- Currently, the variant has been reported in roughly 94 countries.
- Early research suggests it's **50% more transmissible than other variants, and potentially 35% more deadly than the standard virus**. Luckily, studies suggest that some of the existing vaccines work well against it.



B.1.351

- In October 2020, the second major variant was discovered—B.1.351. **It was first identified in South Africa**, but by end of the year, it had spread to the UK, Switzerland, Australia, and Japan.

National Schemes/Programmes

S. NO.	SCHEMES/ PROGRAMS	LAUNCHED DATE	OBJECTIVE
1.	Beti Bacchao, Beti Padhao Yojana (BBBPY)	January 2015	To generate awareness and improving the efficiency of welfare services meant for women.
2.	Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY)	July 2015	Electric supply feeder separation and distribution infrastructure including metering at all levels in rural areas.
3.	Digital India	July 2015	To deliver government services to citizens electronically by improving online infrastructures and by increasing internet connectivity.
4.	Gram Uday Se Bharat Uday Abhiyan (GUSBUA)	April 2014	This scheme strengthens Panchayati raj villages and ensures social harmony in villages.
5.	Make in India	September 2014	To encourage multinational and domestic companies to manufacture their products in India and create jobs and skill enhancement in 25 sectors
6.	Mission Indradhanush	December 2014	To immunize all children as well as pregnant women against diseases by 2020.
7.	Namami Gange Project (NGP)	July 2014	To integrate the efforts to clean and protect the Ganga-river in a comprehensive manner.
8.	Pradhan Mantri Awas Yojana (PMAY)	June 2015	Achieve housing for all by the year 2022, 2 crores in urban and 3 crores in homes in rural areas.
9.	Pradhan Mantri Fasal Bima Yojana (PMFBY)	October 2014	Provide insurance cover to rabi and kharif crops and financial support to farmers in case of damage of crops.
10.	Pradhan Mantri Garib Kalyan Yojana (PMGKY)	April 2015	Implement the pro-poor welfare schemes in more effective way and reaches out to more poor population across the country.
11.	Pradhan Mantri Gram Sinchai yojana (PMGSY)	July 2015	Irrigating the field of every farmer and improving water use efficiency to provide “Per Drop More Crop”.
12.	Pradhan Mantri Jeevan Jyoti Yojana (PMJJY)	May 2015	Provide life insurance cover to all Indian citizens.
13.	Pradhan Mantri Kaushal Vikas yojana	January 2017	Aims to train Indian youth for overseas employment.
14.	Swachh Bharat Abhiyan (SBA)	October 2014	To fulfill Mahatma Gandhi’s dream of clean and hygienic India.
15.	Saubhagya Yojana	September 2017	To provide electricity connections to all households without access to power
16.	Pradhan Mantri Jan Arogya Yojana (PMJAY)	September 2018	Provides health insurance to economically vulnerable populations, also called Ayushman Bharat
17.	Pradhan Mantri Shram Yogi Mandhan	February 2019	Provides pension benefits for workers in the unorganized sector
18.	PM KUSUM Scheme	February 2019	Promotes solar energy, especially for farmers through solar pumps

Antonyms

An antonym is a type of word that has the opposite meaning to another word

WORD	HINDI MEANING	ANTONYM	HINDI MEANING
Transparent	पारदर्शी	Opaque	अपारदर्शी
Fragmented	बिखरा हुआ	Combine/Unite	जुड़ा हुआ
Introvert	अंतर्मुखी	Extrovert	बहिर्मुखी
Ascend	चढ़ना	Descend	उतरना
Save	बचाना, सुरक्षित रखना	Lose	त्यागना
Mortal	नश्वर	Immortal	अनश्वर
Awkward	फूहड़, बेढंगा	Graceful	शोभायमान
Diligently	कर्मठतापूर्वक	Negligently	बेपरवाही से
Persist	डटे रहना, कायम रहना	Discontinue	रुकना, छोड़ देना
Traitor	कपटी, देशद्रोही	Ally	मित्रपक्ष, मैत्री करना
Enrich	समृद्ध बनाना, सम्पन्न	Deprive	वंचित करना
Amateur	शौकिया	Professional	पेशेवर
Heavenly	अलौकिक	Earthly	लौकिक
Perfect	सम्पूर्ण	Imperfect	अपूर्ण
Variable	अस्थिर, परिवर्तनीय	Invariable	स्थिर, अपरिवर्तनीय
Vertical	लम्बवत्	Horizontal	क्षैतिज
Ability	योग्यता	Inability	अयोग्यता
Precise	सटीक, ठीक	Imprecise	गलत
Constructive	सृजन, निर्मित वस्तु	Destructive	विध्वंसकारक
Extravagant	खर्चीला, अतिव्ययी	Thrifty	किफायती
Pretentious	आडंबरपूर्ण	Unpretentious	आडंबररहित
Odd	असमान, अंतर	Even	समान
Mitigate	कम करना	Increase	बढ़ना
Accumulated	संचित	Squandered	लुटाया या उड़ाया गया
Fickle	अस्थिर	Firm	स्थिर
Visionary	काल्पनिक	Realistic	वास्तविक
Theoretical	सैद्धान्तिक	Practical	व्यावहारिक
Barren	बंजर	Fertile	उपजाऊ
Transience	क्षणिक होना	Eternity	अनंत काल
Minuscule	बहुत छोटा, छोटा अक्षर	Majuscule	बड़ा, बड़ा अक्षर
Detest	घृणा करना	Adore	बहुत चाहना
Invincible	अजेय, अपराजेय	Conquerable	विजेय
Vanquish	जीतना	Surrender	समर्पण, हार
Efficacious	प्रभावशाली	Inefficacious	अप्रभावी
Outrageous	उपद्रवी	Jolly	मिलनसार
Sacred	पवित्र	Profane	अपवित्र

Glacial	ठंडा, जमने जैसा	Cool, Frosty, Icy, Freezing, Chill
Garrulous	बातूनी	Talkative, Verbose, Chatty, Gossipy, Gushing
Solitary	अकेला	Lonely, Alone, Seclude, Lonesome
Mundane	साधारण, लौकिक	Ordinary, Worldly, Temporal, Terrestrial, Unexciting, Monotonous, Dull, Boring
Protrude	उभरना	Bulge, Jut, Emerge, Bug out
Fetch	लाना, ले आना	Bring, Get, Pickup, Take
Absurd	बेतुका, भद्दा	Ridiculous, Goofy, Preposterous, Ludicrous
Hurdle	बाधा	Obstacle, Barrier, Impediment, Hindrance
Insolent	अवज्ञाकारी	Disrespectful, Rude, Impertinent, Impolite
Coarse	अपरिष्कृत	Rough, Crude, Inelegant, Unimproved
Demise	देहान्त, निधन	Death, Quietus, Decease, Passing
Mimic	नकल, अनुकरण करना	Copy, Imitate, Impersonate, Resemble
Innocuous	सीधा–साधा, अहानिकर	Inoffensive, Innocent, Harmless, Non-dangerous
Speculate	अंदाज लगाना	Guess, Conjecture, Surmise, Suppose
Effect	प्रभाव डालना, परिणाम	Result, Impone, Influence, Consequence
Instant	क्षणिक, तात्कालिक	Prompt, Plumb, Immediate, Quick
Diligent	मेहनती, परिश्रमी	Industrious, Assiduous, Hard- working, Sedulous
Anticipate	पूर्वानुमान करना, आशा रखना	Expect, Hope, Predict, Forestall
Change	बदलना, हेर–फेर करना	Alter, Modify, Convert, Exchange
Request	अनुरोध करना, प्रार्थना करना	Ask, Entreaty, Solicitation, Requisition
Obscene	अश्लील, घृणित	Dirty, Nasty, Filthy, Foul
Fragrance	सुगंध	Aroma, Incense, Scent, Perfume
Restrict	रोकना, बाधित करना	Prohibit, Constrain, Obstruct, Inhibit
Abundant	पर्याप्त, ज्यादा	Plentiful, Copious, Profuse, Ample
Pity	दया, करुणा	Mercy, Compassion, Clemency, Ruth

Idioms and Phrases

An idiom is a phrase that has a figurative meaning, whereas a phrase is a group of words that have a literal meaning

IDIOMS AND PHRASES	MEANING AND EXAMPLE
Heart and soul	**(The central core of something)** He threw himself heart and soul to pass the examination.
Head and shoulder	**(Above all)** Shri Man Mohan Singh is head and shoulder above his counter parts.
Helter skelter	**(Disorderly)** On arrival of the police the strikers ran helter skelter.
First and foremost	**(First of all)** To be sincere and devoted is the first and foremost requirement for this job.
Might and main	**(Great physical strength)** If you study with might and main you will positively secure the success.
Milk and water	**(Insipid weak)** The foreign policy of India is nothing more than a milk and water policy.
Live-wire	**(Energetic person)** India needs live-wire scientists who can put the country on the fast track of progress.
Ins and outs	**(The intricate details of situation)** Before starting any new business you must know all ins and outs of it.

One who makes an official examination of accounts	**Auditor**	A gathering at a religious place	**Congregation**
A person who deliberately sets fire to a building	**Arsonist**	Submission to all that happens as inevitable	**Fatalism**
That which cannot be effaced	**Indelible**	Lasting for a very short time	**Ephemeral**
To sweep over something so as to surround it completely	**Engulf**	A person who is easily deceived or tricked	**Gullible**
To take someone somewhere suddenly and quickly	**Whisk**	An act of misappropriation of money	**Embezzlement**
A symbol that serves as an emblem of a group of people	**Totem**	Obsession with books	**Bibliomania**
To slap with one's hand or a flat object	**To spank**	To make (someone) anxious or unsettled	**To perturb**
A person who talks too much of himself	**Egotist**	Diminish in value over a period of time	**Depreciate**

Spelling Mistake

❑ INTRODUCTION

The act or process of forming words correctly from individual letters is called spelling. It is the actual way in which a word is spelt.

- One-syllable words ending in **single vowel + single consonant** double the consonant before a suffix beginning with a vowel
  (i) Beg+ed = begged (ii) Big + er = bigger
  (iii) Swim + ing = swimming (iv) Sad + ent = saddest
- Words of **two or three syllables ending** in **single vowel + single consonant** double the final consonant if the syllable is stressed. E.g.
  (i) Permit + ed = permitted (ii) Control + er = controller
  (iii) Occur + ing = occurring (iv) Begin + ing = beginning
- Consonant **'l' is doubled in the words ending in single vowel** + 'l' before a suffix beginning with a vowel. E.g.
  (i) Signal + ing = signalling (ii) Quarrel +ed = quarrelled
  (iii)Repel + ent = repellent (iv) Travel + er = traveller
- When the suffix 'full' is added to a word, one 'l' is removed.
  (i) Faith+ full = faithful (ii) Use + full = useful
- If the word to which the suffix 'full' is added **ends in 'll', one 'l'** is removed from the word also. E.g.
  (i) Skill + full = skilful (ii) Will + full = wilful
- Words ending in **silent 'e', drop** the 'e' before a suffix beginning with a vowel.
  (i) Hope + ing = hoping (ii) Live + ed = lived
  (iii) Drive + er = driver (iv) Tire + ing = tiring
- If the suffix begins with a **consonant, 'e' is not dropped**.
  (i) Hope +full = hopeful (ii) Sincere + ly = sincerely

Inconsequential	Inconstancy	Inconceivable
Independence	Independent	Incorrigible
Individually	Industries	Indeterminate
Intelligent	Intellect	Insusceptible
Interlining	Interceding	Intelligence
Improbability	Improvement	Impressionist
Inattentively	Incessantly	Inappeasable
Incomparable	Incomprehensible	Incidentally
Ideally	Ideologies	Ignoramus
Idiomatic	Idiosyncrasy	Ignorance
Icicle	Idiocy	Ignorant
Insincere	Imbibing	Inoculate

J		
Jettison	Jocundity	Jolliness
Jovially	Judgement	Judicially
Juiciness	Juvenile	

K		
Kidnaped	Kindlier	Kinescope
Kaleidoscope	Keenness	Khaki

L		
Literally	Literature	Litigation
Liveliest	Livelihood	Liveliness
Lives	Lodging	Loneliness
Lonely	Longitudinal	Looniness
Loose	Lugubrious	Losing
Languorous	Laureate	Learnedly
Lassitude	Lengthening	Leniency
Laboriously	Labyrinth	Laboratory
Lamentable	Laconic	Lascivious
Legibility	Levying	Liberally
Lethally	Licentious	Limousine
Libidinous	Lineage	Listener
Linage	Literary	Literate

M		
Maturing	Matriculating	Maturely
Manifesto	Manginess	Maniacal
Marauder	Manning	Manually
Mucilage	Mosquitoes	Mousiness
Mundanely	Multiplicity	Multitudinous
Malleable	Maintenance	Malefactor
Maneuver	Manageability	Management
Mechanics	Mausoleum	Measurement
Medicine	Medallion	Medical
Morbidity	Moodily	Morally
Mosaic	Morosely	Mortally
Menacingly	Memorability	Memorizing
Microscopic	Mentally	Merchandise
Mutuality	Munificent	Musically
Miniature	Mimicker	Mincingly
Miraculous	Minority	Minuscule
Misshapen	Mischievous	Misconstruing

N		
Notoriety	Nevertheless	Nuisance
Neurotic	Necessary	Nicety
Niggardly	Noticing	Nimbly
Nauseate	Nihilism	Needlessly
Nineteen	Ninetieth	Nominally
Negativism	Normally	Nostalgia
Noncombustible	Negligence	Negligible
Negroes	Neighbour	Neither
Naive	Naivete	Narcissus
Narrative	Naturalistic	Naturally

O		
Ordinarily	Oppression	Occasion
Offense	Ostenadous	Occur
Officious	Obliquely	Optimism
Occurrence	Obsequious	Omateness
Odoriferous	Orating	Over Development
Obtuseness	Ordimary	Opportunity
Occupying	Offensively	Ostracism
Outweigh	Omission	Obliterate
Ornamental	Oculist	Observance

P		
Poetically	Poignant	Polyethylene
Permanent	Perfunctory	Persistent
Personal	Perpetually	Personnel
Passed	Passionately	Passable
Pasteurize	Pathetically	Passivity
Penicillin	Penitent	Penetrate
Perambulating	Perceive	Penniless
Percipience	Peremptorily	Perceptible
Performance	Perfidious	Perilous
Phosphoric	Phobia	Phraseology
Physician	Photogenic	Physique
Pantomime	Phenomenon	Pancreas
Paralleled	Painstaking	Parallel
Pharmaceutical	Paradoxically	Philosophy
Phlegmatic	Paralyzed	Phonetically
Pageant	Petticoat	Pacified
Palpitating	Pamphlets	Palladium
Piccolo	Pictorially	Piecing
Pinnacle	Piquancy	Pirouette
Pedagogy	Pedantic	Pedagogue

Q		
Querulous	Questionnaire	Queasiness
Quiescent	Quintessence	Queue
Quixotic	Quotable	Quipster, Quotient

General Science

1. Blades of a windmill possess, hence they are turned by a fast wind.
   Answer :- Potential Energy
2. A dark-skinned man experiences, as compared to a fair-skinned man.
   Answer :- Less heat & less cold
3. What device is used to break/complete an electronic circuit
   Answer :- Switch
4. What is the temperature at which both the Fahrenheit and the centigrade scales have the same value
   Answer :- -40°
5. Acceleration acts always in the direction of the
   Answer :- Net force
6. The principle used in working of an atom bomb is
   Answer :- Nuclear Fission
7. What is the unit used to measure the depth of sea
   Answer :- Fathom
8. Astigmatism can be corrected by
   Answer :- Cylindrical lenses
9. Lambert's Law is related to
   Answer :- Illumination
10. In a Battery, which energy is converted into Electrical energy
    Answer :- Chemical Energy
11. The longitudinal mechanical waves of less than 20 Hz are called
    Answer :- Infrasonic
12. Distance of stars are measured in
    Answer :- Light Years
13. Albert Einstein was awarded the Noble prize for
    Answer :- Photoelectric Effect
14. Electric Motor converts the Electric energy into
    Answer :- Electric energy to Mechanical energy
15. Robert Koch has invented the
    Answer :- Electron microscope
16. Force of attraction between the molecules of different substances is called
    Answer :- Adhesive Force
17. Electrons in Good conductors are
    Answer :- Loosely bound
18. One barrel of oil = litres. (Approximately)
    Answer :- 159
19. If a bar magnet is cut length wise into 3 parts, what will the total number of poles be
    Answer :- 6
20. If the body is hollow, then its centre of gravity lies
    Answer :- Outside the material
21. If the temperature inside a room is increased, the relative humidity will
    Answer :- Decrease
22. In summer, the mirages are seen due to the phenomenon of
    Answer :- Total Internal Reflection
23. In the visible spectrum which colour has the longest wavelength
    Answer :- Red
24. In which medium sound travels faster
    Answer :- Solid
25. Insects can move on the surface of water without sinking due to
    Answer :- Surface tension of water

❑ GOVERNMENT SCHEMES [INDIA & STATES]

1. **'Praja Palana Guarantee Darakasthu'** is related to **Telangana.**
2. The **Uttarakhand** government has prohibited government offices from purchasing petrol and diesel vehicles from **January 1, 2024.**
3. The food security scheme in **Rajasthan**, previously known as **Indira Rasoi Yojana,** has been renamed **Shree Annapurna Rasoi Yojana.**
4. The state of **West Bengal** has recently introduced a **comprehensive social welfare scheme named Yogyasree.**
5. **iDEX-DIO** is the flagship scheme of the **Ministry of Defence.**
6. The state of **Assam** has recently launched the '**Lakhpati Baideos' scheme.**
7. The **Ministry of Housing and Urban Affairs** is responsible for the **PM-eBus Sewa scheme.**
8. The state of **Chhattisgarh** recently launched the **Mahtari Vandana Yojana**.
9. The scheme that provides scholarships to meritorious students from **Scheduled Caste communities** for higher education is **SHRESHTA scheme.**
10. **Mukhya Mantri Mahila Udyamita Abhiyaan** was launched by the **Assam government.**
11. The primary targets of the **PM Young Achievers Scholarship Award Scheme (PM YASASVI)** are **OBCs, EBC, and DNT students.**
12. The **LABHA ('Laghu Bana Jatya Drabya Kraya') Yojana** was launched by the **state of Odisha.**
13. The **Saksham Anganwadi and Poshan 2.0 scheme** is implemented by the **Ministry of Women and Child Development.**
14. The state government of **Telangana** recently launched **'Operation Smile X'** to rescue child labourers.
15. The state government of **Karnataka** has recently suspended five officers for negligence in implementing the **IEDSS scheme.**
16. **Kamakhya Divyalok Pariyojana** is associated with the state of **Assam.**
17. The **Mera Gaon Meri Dharohar** programme comes under the **Ministry of Culture.**
18. The **Open Network Digital Commerce (ONDC)** portal was launched by the **Ministry of Commerce and Industry.**
19. The renewed portal of the **Animal Husbandry Infrastructure Development Fund** was launched by the **Ministry of Fisheries, Animal Husbandry & Dairying.**
20. **Mukhyamantri Kanya Sumangala Yojana** is an initiative of the state of **Uttar Pradesh.**
21. The **ADITI scheme** is associated with the **Defence sector.**
22. The **Electric Mobility Promotion Scheme 2024** was introduced by the **Ministry of Heavy Industries.**
23. **Rashtriya Arogya Nidhi (RAN)** scheme is administered by the **Ministry of Health and Family Welfare.**

17. **Singapore** introduced a **new sustainability law** to become a carbon-neutral city-state by 2030.
18. **Russia** and **India** held a **bilateral trade summit**, focusing on energy and defense cooperation in 2024.
19. **Israel** and **Palestine** reached a historic **peace agreement** to end years of conflict in 2024.
20. **Mexico** expanded its **drug trafficking prevention program** to curb violence and criminal activity in 2024.
21. **Egypt** hosted the **World Climate Summit** in 2024, focusing on global environmental policy.
22. **Australia** became the first country to launch a **national AI ethics framework** in 2024.
23. **UNESCO** declared the **Great Barrier Reef** a **World Heritage Site of the Year** in 2024 for its conservation efforts.
24. **Brazil** introduced a **universal healthcare reform** aimed at improving access to medical services in 2024.
25. **Turkey** and **Greece** reached a **historic agreement on maritime boundaries** in the Eastern Mediterranean in 2024.
26. **United Nations** launched a **global education initiative** to combat illiteracy in developing nations in 2024.
27. **Nigeria** successfully hosted the **African Union Summit** in 2024, focusing on economic growth and unity.
28. **Italy** passed a **comprehensive digital taxation law**, targeting multinational corporations in 2024.
29. **New Zealand** implemented a **nationwide carbon tax** to reduce emissions and promote sustainability in 2024.
30. **Argentina** announced the opening of a **new space research center** to enhance its role in space exploration in 2024.
31. **Sweden** introduced a **national healthcare access program** to reduce inequalities in medical treatment in 2024.
32. **United Arab Emirates** launched the **first solar-powered airport terminal** in the Middle East in 2024.
33. **South Africa** became the **first African country** to host the **International Trade and Investment Conference** in 2024.
34. **Norway** introduced a **sustainable seafood certification** to boost environmentally friendly fishing practices in 2024.
35. **Argentina** and **Chile** announced a **joint initiative for water conservation** to protect shared water sources in 2024.
36. **Finland** topped the **World Happiness Report** for the **sixth consecutive year** in 2024.
37. **Cuba** and **United States** resumed diplomatic relations after **years of tensions** in 2024.
38. **Spain** passed a **new labor rights law**, securing better wages and conditions for workers in 2024.
39. **Thailand** became the **first Asian country** to legalize **same-sex marriage** in 2024.
40. **India** hosted the **Asia-Pacific Economic Cooperation (APEC) summit** in 2024, discussing regional trade and security issues.
41. **China expanded its Belt and Road** Initiative by signing infrastructure agreements with **10 new countries in 2024.**

Reasoning, Aptitude and General Arithmetic

Analogy

- Analogy means a similarity or comparability between two things, where both the things are related to each other in a certain way. In these types of questions, a **series** of **numbers** or **alphabetical** letters or **combinations** of both are given.

❑ TYPES OF VERBAL ANALOGY

1. Analogy based on Words

In these types of questions, three words are given and two words are inter-related to each other in some way. It is required to find out the relationship between the third and fourth word on the basis of the relationship of the first two words.

Example: Skin : Feel :: Eye : _____?

(a) Tears (b) Taste (c) Smell (d) Vision

Answer :- (d) The sense of skin is feeling and that of eye is vision.

2. Analogy based on Numbers

In these types of questions, three numbers are given and two numbers are inter-related to each other in some way. The student is required to find out the relationship between the third and fourth number on the basis of the relationship of the first two numbers.

Example: 26 : 5 :: 65 : _____?

(a) 9 (b) 8 (c) 7 (d) 6

Answer :- (b) The relationship between the first two numbers can be identified as Number Analogy i.e., The first number is the square+1 of the second number. So, the 65 will be the square+1 of number 8.

3. Analogy based on Alphabets

In these types of questions, a student is required to find out the relationship between two given groups of alphabetical letters inter-related to each other in some way and then choose either a letter group or pair consisting of similarly related letter groups.

Example: BUCKET : ACTVBDJLDFSU :: BONUS : _____?

(a) CDPQOPVWTU (b) SUNOR (c) ACNPMOTVRT (d) ACNPMOVWTU

Answer :- (c) In this case each letter of first group gets replaced by two letters, where one letter comes before it and one comes after that particular letter in the second group.

B – AC; O – NP; N – MO; U – TV; S - RT

15. CIG, FLJ, IOM,
(a) LRP (b) JLG
(c) PSU (d) QUB

16. m n m n m n n n m m n m n m m m m n n m m n
How many m's are preceded by 'm' and followed by 'n'
(a) 2 (b) 3
(c) 4 (d) 1

17. BZA, DYC, FXE, ?, JVI
(a) HUG (b) HWG
(c) UGH (d) None of these

18. RAP, MAP, HOT FUN,
(a) HNE (b) PGI
(c) STN (d) CAT

19. C, E, H, L, Q,
(a) R (b) W
(c) U (d) X

20. NMO, RQS, VUW, ZYA,
(a) DCE (b) BCD
(c) ECD (d) FCD

ANSWER KEY									
1 – a	2- c	3- d	4 – c	5 – b	6 - d	7 - c	8 – b	9 -b	10 – d
11 – a	12 – c	13 – d	14 – c	15 – a	16 -b	17- b	18 – d	19 – b	20 - a

Classification

- **'Classification'** means to list the items of a given group on the basis of certain quality and then choose the stranger out.
- In these types of Questions, the candidate is required to choose one item which does not fit into the group of similar items.

❑ TYPES OF CLASSIFICATION

1. Type I: Selecting the odd WORD

Example: **Select the word which is least like the other words in the group**

(a) Dagger (b) Hammer (c) Knife (d) Sword

Answer: (b) - Here all are sharp edged and having a cutting action EXCEPT Hammer.

2. Type II: Selecting the odd PAIR OF WORDS

Example: **Choose the odd pair of words**

(a) Oil: Lamp (b) Power: Machine (c) Oxygen: Life (d) Petrol: Ventilator

Answer: (d) - Clearly in all the pairs second requires the first to function.

3. Type III: Selecting the odd NUMERAL

Example: **Choose the number which is different from others in the group**

(a) 17 (b) 27 (c) 29 (d) 37

Answer :- (b) Each of the numbers except 27 is a prime number.

4. Type IV: Selecting the odd NUMERAL GROUP OR NUMERAL PAIR

Example: **Choose the number which is different from others**

(a) 21-49 (b) 24-64 (c)18-35 (d) 27-81

Answer: (c) In all other numbers, the second number is the square of one-third of the first number.

5. Type V: Selecting the odd LETTER GROUP

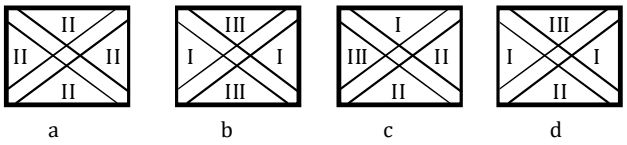
Example: **Choose the group of letters which is different from others**

(a) APBQ (b) CRDT (c) EUFV (d) GWHX

Answer: (b) In all other, the first and the third as well as the second and the fourth are consecutive letters in the English alphabet.

6. Type VI: Selecting the odd FIGURE OR IMAGE

Example: Find out the figure which does not belong to the group.



a b c d

(a) a (b) b (c) c (d) d

Answer: (d) Except figure (d) All other figures have total 8 I's in the blanks.

MULTIPLE CHOICE QUESTIONS

1. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) New Delhi (b) Beijing
(c) New York (d) Tokyo

2. Three of the following four options are alike in a certain way and so form a group. Which one does not belong to that group

(a) Tongue (b) Chin
(c) Nose (d) Ear

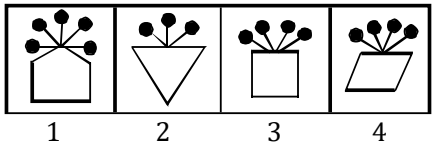
3. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Tortoise (b) Duck
(c) Snake (d) Whale

4. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Feathers (b) Tentacles
(c) Pseudopodia (d) Flagella

5. Choose the figure which is different from the rest



1 2 3 4

(a) 1 (b) 2 (c) 3 (d) 4

6. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Fog (b) Hailstone
(c) Vapour (d) Mist

7. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Hydrogen (b) Oxygen
(c) Iodine (d) Nitrogen

8. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Raid (b) Assault
(c) Defence (d) Ambush

9. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Parrot (b) Pigeon
(c) Kite (d) Penguin

10. In this question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one

(a) Birbal (b) Abul Fazal
(c) Tansen (d) Faiz Ahmed

MULTIPLE CHOICE QUESTIONS

1. If in a certain language CHAMPION is coded as HCMAIPNO, how can NEGATIVE be coded in that code
   (a) ENAGITEV (b) NEAGVEIT
   (c) MGAETVIE (d) EGAITEVN
2. In a certain language KINDLE is coded as ELDNIK, how can EXOTIC be coded in that code
   (a) EXOTLC (b) CXOTIE
   (c) COMTE (d) CITOXE
3. If in a certain language GAMBLE is coded as FBLCKF, how can FLOWER be coded in that language
   (a) GKPVFQ (b) EMNXDS
   (c) GMPVDS (d) HNQYGT
4. If in a certain language FASHION is coded as FOIHSAN, how can PROBLEM be coded in that code
   (a) ROBLEMP (b) PLEBRUM
   (c) PRBOELM (d) PELBORM
5. If FRIEND is coded as HUMJTK, how can CANDLE be written in that code
   (a) EDRIRL (b) DCQHQK
   (c) ESJFME (d) FYOBOC
6. If in a certain code, TWENTY is written as 863985 and ELEVEN is written as 323039, how can TWELVE be written in that code
   (a) 863203 (b) 863584
   (c) 863903 (d) 863063
7. If PALE is coded as 2134, EARTH is coded as 41590, how can is PEARL be coded in that language
   (a) 29530 (b) 24153
   (c) 25413 (d) 25430
8. If ROSE is coded as 6821, CHAIR is coded as 73456 and PREACH is coded as 961473, what will be the code for SEARCH
   (a) 246173 (b) 214673
   (c) 214763 (d) 216473
9. In a certain code "nee tim see" means "how are you" ; "blee nee see" means "where are you". What will be the code for "where"
   (a) nee (b) tim (c) see (d) blee
10. In a certain code language "pit nae tom" means "apple is green" ; "nae ho tap" means "green and white" and "ho tom ka" means "shirt is white". Which of the following represents "apple" in that language
    (a) nae (b) tom (c) pit (d) ho
11. If "nitco sco tingo" stands for "softer than flower", "lingo rho mst" stands for "sweet flower fragrance" and "mst sco trop" stands for "sweet than smile" what would "fragrance" stand for
    (a) rho (b) mst (c) tmp (d) sco
12. In a certain code language, 743 means "Mangoes are good", 657 means "Eat good food", and 934 means "Mangoes are ripe". Which digit means "ripe" in that language
    (a) 5 (b) 4 (c) 9 (d) 7
13. In a certain code, 247 means "spread red carpet", 256 means "dust one carpet" and 234 means "one red carpet" which digit in that code means "dust"
    (a) 2 (b) 3 (c) 5 (d) 6
14. In a certain code language, 134 means "good and tasty", 478 means "see good pictures", and 729 means "pictures are faint". Which of the following digits stands for "see"
    (a) 4 (b) 7 (c) 9 (d) 8
15. In a certain code 253 means "books are old", 546 means "man is old" and 378 means "buy good books". What stands for "are" in that code
    (a) 2 (b) 4 (c) 5 (d) 6
16. In a certain code language TSSNOFFQ is written as STRONGER, then GQFDENN will be written as
    (a) DOMEERF (b) FEEDORM
    (c) FREEDOM (d) FREEDMO

17. If FULFNHW is the code for CRICKET. EULGH will be coded as
(a) PRIDE (b) BRIDE
(c) BLADE (d) BLIND

18. If in a certain language REMOTE is coded as ROTEME. Which word would be coded as PNIICC
(a) NPIICC (b) PICCIN
(c) PINCIC (d) PICNIC

19. In a certain code ORANGE is written as "? + @ • + *" and EAT is written as "* @ $". How can ROTATE be written in that code
(a) + ? $ @ * $ (b) + ? $ @ • *
(c) + ? $ @ $ * (d) + ? $ * • @

20. If in a certain code language 'ROPE' is written as, '% 5 7 $', 'DOUBT' is written as '3 5 # 8 *', and 'LIVE' is written as '@ 2 4 $', then how will 'TROUBLE' be written in that language
(a) * % 5 # 8 @ $ (b) * % 8 @ $ 5 #
(c) % 5 8 * @ $ # (d) # 8 @ $ * % 5

ANSWER KEY									
1 – a	2 – d	3 – b	4 – d	5 – a	6 – a	7 – b	8 – b	9 – d	10 – c
11 – a	12 – c	13 – c	14 – d	15 – a	16 – c	17 – b	18 – d	19 – c	20 – a

Series Completion

In **series completion** questions, **a series of numbers, alphabets and both are given**. These terms follow a certain pattern throughout. The aspirants need to recognize this implicit pattern and use it to complete the series or find the wrong element in the series. Series completion is a very important and trickier topic of both verbal and non-verbal reasoning.

How to prepare for Series completion in Reasoning?

The pattern, which has to recognize can be of various kinds. Once you have identified it, then you can apply it to the other numbers to find out the missing or wrong number in the series. Check below the list of these common patterns, which are most frequently asked in exams.

1. PRIME NUMBERS

When numbers in series are prime numbers, **which are divisible by own and are greater than 1**. There must not be any factor of this number. Such numbers are- **11, 13, 17, 19, etc.**

2. SQUARES/CUBES

When numbers in the series are of **perfect square or perfect cube or perfect square roots or cube root**. Such numbers include **81, 100, 121, 144, etc.** These can be of decimal nature too.

3. PATTERN IN DIFFERENCES

Calculate the differences between the numbers given in the series provided in the question. This difference can be constant or varying in nature. After identifying this difference, you can find the problem number or words or letters in the problem series.

Example: - 2, 7, 12, 17, 22, ?

The difference in this series for every number is **5**. Hence, the next number will be 27.

Example: - A, D, G, J, ?

The difference between the position of these letters is **3**. So, The next third letter to J will be M.

4. PATTERN IN ALTERNATE NUMBERS

Whenever there is a pattern in the alternate numbers or letters or words in the series, then with this alternate pattern, you can easily find the problem number, letter or word.

Example:- 2, 3, 4, 7, 6, 11, ?

In this series, the alternate numbers are incremented by 2 and 4 successively. Hence, the next number will be 8.

Similar can be done to letter series or word series to find the answer.

5. GEOMETRIC SERIES

When numbers in the series follow the geometric progression means when each successive number in the series is obtained by multiplying or dividing the previous numbers with a fixed ratio, then problem number can be easily figured out.

Example: 4, 20, 100, 500, ?

Each number is multiplied by 5 and in geometric progression. Hence, the next number will be 2500.

6. PATTERN IN THE ADJACENT NUMBERS

When adjacent numbers are varying with a logical pattern in the series, it can be understood with the following example.

Example: 2, 4, 12, 48, ?

In this series, first number is multiplied by 2, second number is multiplied with 3 and third one is with 4. Hence, the next number in series will be 48×5=240.

7. ODD ONE OUT

All numbers are same in series but one number is different in the series. Such numbers can be identified for elimination.

8. COMPLEX SERIES

In such series, the differences between numbers are dynamic instead of being fixed, but still there is a clear logical rule.

Example: 3, 8, 15, 24, 33, ?

In this series, numbers are incremented by +5, +7, +9 and +11. Hence, the next number will be increment by +13. So, the solution will be 46.

9. COMPLEX ARITHMETIC FUNCTIONS

In some series, more than one operation (+, x, - and /) is used successively. Such pattern arevery tough to recognize and sometime take a lot of time. So, it is advisable not to spend so much time on such questions. If you find the correct answer under the expected time limits, then only attempt it otherwise switch to the next question.

Example: 4, 6, 12, 14, 28, ?

In this series, each prospective number is incremented by 2 and the next number is multiplied by 2. Hence, applying this logic to the series, the next number will be 30.

MULTIPLE CHOICE QUESTIONS

1. 120, 99, 80, 63, 48, ?

(a) 35 (b) 38 (c) 39 (d) 40

2. 11, 10, ?, 100, 1001, 1000, 10001

(a) 101 (b) 110 (c) 111 (d) 121

3. 5760, 960, ?, 48, 16, 8

(a) 120 (b) 160 (c) 192 (d) 240

4. AZ, GT, MN, ?, YB

(a) JH (b) SH

(c) SK (d) TS

5. AB, DEF, HIJK, ?, STUVWX

(a) LMNO (b) LMNOP

(c) MNOPQ (d) QRSTU

6. One term in the number series is wrong. Find out the wrong term
121, 143, 165, 186, 209
(a) 143 (b) 165
(c) 186 (d) 209

7. 8, 13, 21, 32, 47, 63, 83
(a) 13 (b) 21 (c) 32 (d) 47

8. 125, 80, 45, 20, ?
(a) 5 (b) 8 (c) 10 (d) 12

9. Z, S, W, O, T, K, Q, G, ?, ?
(a) N, C (b) N, D (c) O, C (d) O, D

10. 8, 28, 116, 584, ?
(a) 1752 (b) 3502
(c) 3504 (d) 3508

11. H, I, K, N, ?
(a) O (b) Q (c) R (d) S

12. 1, 5, 13,25, 41, ?
(a) 51 (b) 57 (c) 61 (d) 63

13. 325, 259, 204, 160, 127, 105, ?
(a) 94 (b) 96 (c) 98 (d) 100

14. WFB, TGD, QHG, ?
(a) NIJ (b) NIK (c) NJK (d) OIK

15. One term in the number series is wrong. Find out the wrong term
3, 4, 10, 32, 136, 685, 4116
(a) 10 (b) 32 (c) 136 (d) 4116

16. 15, 16, 22, 29, 45, 70
(a) 16 (b) 22 (c) 45 (d) 70

17. 8, 14, 26, 48, 98, 194, 386
(a) 14 (b) 48 (c) 98 (d) 194

18. 1, 1, 2, 6, 24, ?, 720
(a) 100 (b) 104 (c) 108 (d) 120

19. 1, 2, 6, 7, 21, 22, 66, 67, ?
(a) 70 (b) 134 (c) 201 (d) 301

20. 0.5, 0.55, 0.65, 0.8, ?
(a) 0.9 (b) 0.82 (c) 1 (d) 0.95

ANSWER KEY									
1 – a	2 – a	3 – c	4 – b	5 – c	6 – c	7 – d	8 – a	9 – a	10 – d
11 – c	12 – c	13 – a	14 – b	15 – b	16 – b	17 – b	18 – d	19 – c	20 – c

Logical Sequence of Words

- **Logical sequence** of words as the name implies is that type of reasoning which **consists of words** and we have to **find out a sequence which is logical in that context**.
- Normally, in these questions, **the words are mentioned in serial numbers 1, 2, 3 etc**.
- There should be a minimum of four words to ensure complexity of the question.
- There are is no limit of maximum serial of numbers.
- **The question can arise from different fields.** It may be from **daily life, preparing a dish, office schedule, time table, administration process, oceans and continents, animals and birds etc**. Questions can arise from **all the sectors of the world, all the neighborhood around** us and we have to just **find a logical sequence of these words**.

For example:

1. Wall 2. Sand 3. Cement 4. Brick 5. Water

Explanation: Here five words are given. First, we need to read all the five words. It is wall, sand, cement, brick and water. Now we can imagine that it is a question on construction. So, we know that **first sand is put on ground then cement is added to the sand and they are mixed. After mixing, water is added to the mixture then the mixture is used with brick to make a wall**. So, the logical sequence of the words is as follows:

Sand, Cement, Water, Brick, and Wall.

4. In the following question of logical sequence of words, find the correct answer
1. Crop 2. Root 3. Stem
4. Seed 5. Flower
(a) 2, 4, 5, 1, 3 (b) 4, 2, 3, 5, 1
(c) 2, 3, 4, 1, 5 (d) 2, 3, 5, 1, 4

5. In the following question of logical sequence of words, find the correct answer
1. Frog 2. Eagle
3. Grasshopper 4. Snake 5. Grass
(a) 5, 3, 4, 2, 1 (b) 1, 3, 5, 2, 4
(c) 5, 3, 1, 4, 2 (d) 3, 4, 2, 5, 1

6. In the following question of logical sequence of words, find the correct answer
1. Trillion 2. Thousand 3. Billion
4. Hundred 5. Million
(a) 1, 2, 4, 3, 5 (b) 1, 5, 3, 2, 4
(c) 4, 2, 3, 5, 1 (d) 4, 2, 5, 3, 1

7. In the following question of logical sequence of words, find the correct answer
1. Curd 2. Grass 3. Butter
4. Milk 5. Cow
(a) 2, 5, 4, 3, 1 (b) 4, 2, 5, 3, 1
(c) 5, 2, 3, 4, 1 (d) 5, 2, 4, 1, 3

8. In the following question of logical sequence of words, find the correct answer
1. Mother 2. Child 3. Milk
4. Cry 5. Smile
(a) 1, 5, 2, 4, 3 (b) 2, 4, 1, 3, 5
(c) 2, 4, 3, 1, 5 (d) 3, 2, 1, 5, 4

9. In the following question of logical sequence of words, find the correct answer
1. Gold 2. Iron 3. Sand
4. Platinum 5. Diamond
(a) 2, 4, 3, 5, 1 (b) 3, 2, 1, 5, 4
(c) 4, 5, 1, 3, 2 (d) 5, 4, 3, 2, 1

10. In the following question of logical sequence of words, find the correct answer
1. Table 2. Tree 3. Wood
4. Seed 5. Plant
(a) 4, 5, 3, 2, 1 (b) 4, 5, 2, 3, 1
(c) 1, 3, 2, 4, 5 (d) 1, 2, 3, 4, 5

11. In the following question of logical sequence of words, find the correct answer
1. College 2. Child 3. Salary
4. School 5. Employment
(a) 1, 2, 4, 3, 5 (b) 2, 4, 1, 5, 3
(c) 4, 1, 3, 5, 2 (d) 5, 3, 2, 1, 4

12. In the following question of logical sequence of words, find the correct answer
1. Cutting 2. Dish 3. Vegetable
4. Market 5. Cooking
(a) 1, 2, 4, 5, 3 (b) 3, 2, 5, 1, 4
(c) 4, 3, 1, 5, 2 (d) 5, 3, 2, 1, 4

13. In the following question of logical sequence of words, find the correct answer
1. Milky way 2. Sun 3. Moon
4. Earth 5. Stars
(a) 4, 2, 3, 1, 5 (b) 3, 4, 2, 5, 1
(c) 2, 3, 4, 5, 1 (d) 1, 4, 3, 2, 5

14. In the following question of logical sequence of words, find the correct answer
1. Sea 2. Rivulet 3. Ocean
4. River 5. Glacier
(a) 5, 4, 3, 2, 1 (b) 5, 4, 2, 3, 1
(c) 5, 2, 4, 1, 3 (d) 5, 2, 1, 3, 4

15. In the following question of logical sequence of words, find the correct answer
1. Poverty 2. Population
3. Death 4. Unemployment
5. Disease
(a) 3, 4, 2, 5, 1 (b) 2, 4, 1, 5, 3
(c) 2, 3, 4, 5, 1 (d) 1, 4, 3, 2, 5

16. In the following question of logical sequence of words, find the correct answer
1. Birds 2. Winter 3. Migration
4. India 5. Siberia
(a) 4, 1, 2, 3, 5 (b) 3, 1, 2, 4, 5
(c) 5, 2, 1, 3, 4 (d) 4, 1, 2, 5, 3

17. In the following question of logical sequence of words, find the correct answer
1. Journalist 2. Incident
3. Newspaper 4. Article 5. Public

MULTIPLE CHOICE QUESTIONS

1. In the following question, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column wise. Find out this trend and choose the missing character accordingly.

72	24	6
96	16	12
108	?	18

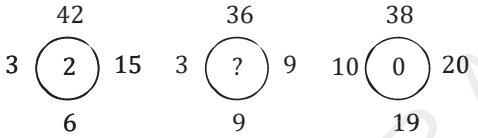
(a) 12 (b) 16 (c) 18 (d) 20

2. In the following question, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column wise. Find out this trend and choose the missing character accordingly.

1	7	9
2	14	?
3	105	117

(a) 26 (b) 20 (c) 16 (d) 12

3. What value replaces "?" in the below figure



(a) 4 (b) 3
(c) 2 (d) 1

4. In the following question, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column wise. Find out this trend and choose the missing character accordingly.

28	60	48
5	6	7
17	30	7
7	?	16

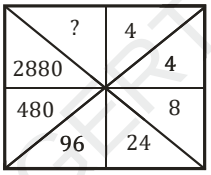
(a) 18 (b) 23 (c) 24 (d) 27

5. In the following question, a matrix of certain characters is given. These characters follow a certain trend, row-wise or column wise. Find out this trend and choose the missing character accordingly

11	6	8
17	12	?
25	34	19
19	28	11

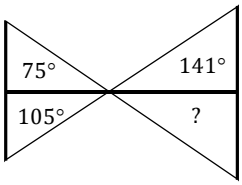
(a) 16 (b) 15
(c) 13 (d) 9

6. Find out this trend and choose the missing character accordingly



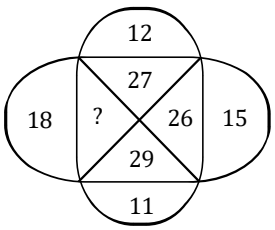
(a) 20160 (b) 20600
(c) 21060 (d) 23040

7. Find out this trend and choose the missing character accordingly



(a) 75° (b) 39°
(c) 45° (d) 120°

8. Find out this trend and choose the missing character accordingly



(a) 32 (b) 35
(c) 25 (d) 30

9. Find out this trend and choose the missing character accordingly

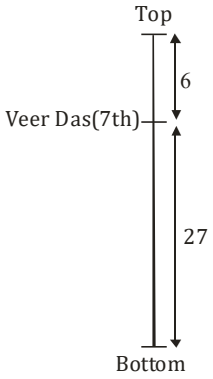
5	4	3	?	23
6	2	5	4	38
12	3	4	1	?

(a) 2 and 51 (b) 4 and 40
(c) 2 and 10 (d) 8 and 25

EXPLANATION

1. Ans (c)

As seen in the figure, Veer Das's position is 7th from the top and 28th from the bottom.



Therefore, total number of students

= 6 + Veer Das + 27 = 34

2. Ans (d)

The given sequence may be analyzed as under:

4 / 45 / 453 / 4531 / 45312 / 45 / 453 / 453

Following the above sequence, the next numberis 1 which stands for 'Run'.

3. Ans (b)

The given number:

5 7 8 4 6 2 1 3 9

After arranging all the digits in ascending order, we get:

1 2 3 4 5 6 7 8 9

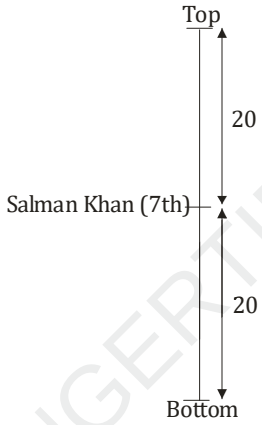
Hence, there are two such digits whose positions are remained unchanged.

4. Ans (b)

According to Kailash, Deepak's birthday falls on one of the days among 21st, 22nd, 23rd, 24th, 25th, 26th and 27th May. According to Geeta, Deepak's birthday falls on one of the days among 13th, 14th, 15th, 16th, 17th, 18th, 19th, 20th and 21st May. The day common to both the groups is 21st May. Deepak's birthday falls on 21st May.

5. Ans (b)

As seen in the figure, Salman Khan's position is 21st from the both ends.

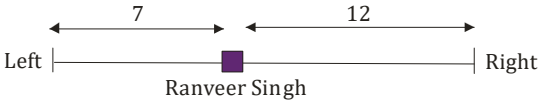


Therefore, total number of students

= 20 + Salman Khan + 20 = 41

6. Ans (b)

As seen in the figure, there are 7 boys to the left of Ranveer Singh and 12 boys to the right of him.



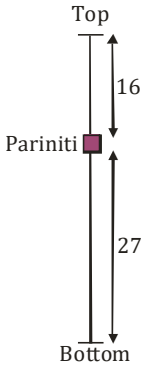
Total number of boys in the line

= 7 + Ranveer Singh + 12 = 20

Hence, number of boys to be added = 30 - 20 = 10.

7. Ans (d)

As given in the figure, there are 16 girls above Pariniti and 27 girls below her among the girls who went into the final round.



Total girls who made it to the final

= 16 + Pariniti + 27 = 44

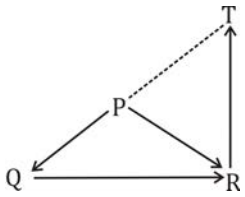
Therefore, total girls who enrolled in the contest

= 44 + 7 + 7 = 58

19. Ans (c)

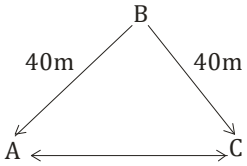
Clearly, the arrangement according to the given directions

Is as shown. So, T lies to the north-eas of P.



20. Ans (a)

As is clear from the abjoining diagrams, C line to the east of A.



Logical Venn Diagram

❑ INTRODUCTION

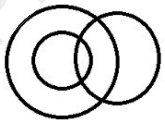
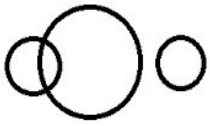
❖ DEFINITION

A diagram represents **mathematical or logical sets pictorially as circles or closed curves** within an enclosing rectangle (the universal set), common elements of the sets being represented by intersections of the circles.

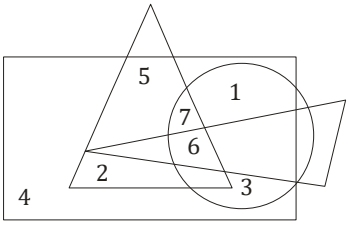
It is a process of showing complex relationship between 2-3 categories diagrammatically through various geometric structures.

Intersection between two geometric structures indicates that they have something in common and total isolation indicates just opposite of that.

The following are the various possible cases of Venn diagram and examples. Among three columns, first one shows the **type of Venn diagram**, second one is for **description** and third one sites an **example** to give a clear picture of the description.

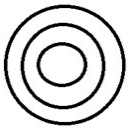
VENN DIAGRAM	APPLICABLE CASES	EXAMPLE
	There will be a series of sub cases one under another.	**Colour>Green>Light green** Light green colour is a sub part of green colour and both of them belongs to colour group.
	One main category, under it two sub categories and both bear some similarities among them.	**Liquids>Petrol, diesel** Here both are flammables in nature, thus bear similarity.
	One category may have one sub category. They both partially satisfy some conditions (not always).	**Vegetable>Capsicum>Red** Some capsicums are red and so as some other vegetables.
	Among three different sections, two may have some common properties those do not match with third one.	**Actor>Headmaster>Queen** From the above, actor and headmaster are showing masculinity, thus bearing some common properties which is just opposite to Queen.

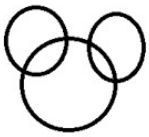
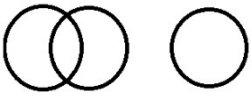
9. Which of the following numbers is present in only 3 geometrical figure



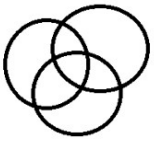
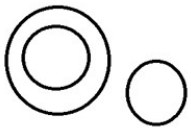
(a) 3 (b) 7 (c) 5 (d) 1

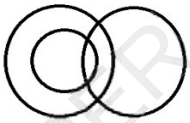
10. Which one of the following venn diagrams correctly illustrates the relationship among the classes: Carrot, Food, Vegetable

(a)  (b) 

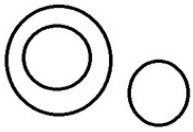
(c)  (d) 

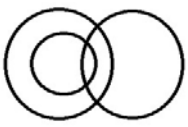
11. Which one of the following venn diagrams correctly illustrates the relationship among the classes: Women, Mothers, Widows

(a)  (b) 

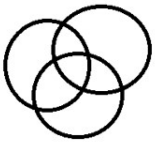
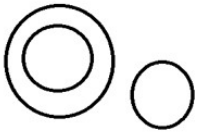
(c)  (d) 

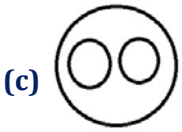
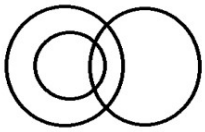
12. Which one of the following venn diagrams correctly illustrates the relationship among the classes: Men, Authors, Teachers

(a)  (b) 

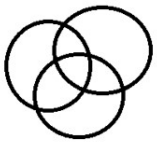
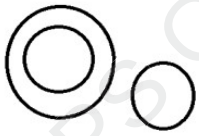
(c)  (d) 

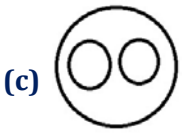
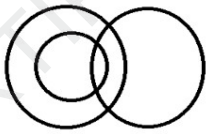
13. Which one of the following Venn diagrams correctly illustrates the relationship among the classes: Sparrows, Birds, Mice

(a)  (b) 

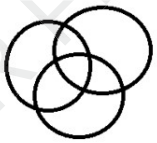
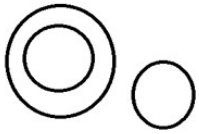
(c)  (d) 

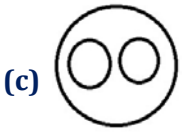
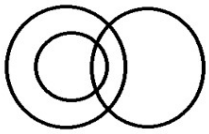
14. Which one of the following venn diagrams correctly illustrates the relationship among the classes: Tea, Coffee, Beverages

(a)  (b) 

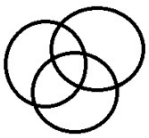
(c)  (d) 

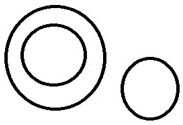
15. Which one of the following venn diagrams correctly illustrates the relationship among the classes: Boys, Students, Athletes

(a)  (b) 

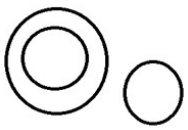
(c)  (d) 

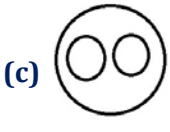
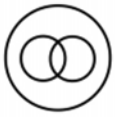
16. Select from the given diagrams, the one that illustrates the relationship among the given three classes: Judge, Thief, Criminal.

(a)  (b) 

(c)  (d) 

17. Choose from the four diagrams given below, the one that illustrates the relationship among the Languages, French, German.

(a)  (b) 

(c)  (d) 

Calender

- A table with the days of each month and week in a year is called "Calendar".
- Each Gregorian calendar year has either 365 or 366 days (the leap day being inserted as 29th February). The smallest unit of a **calendar is 'day'.**

❖ **Day-**We call the different days as Sunday, Monday, Tuesday. Wednesday, Thursday, Friday and there are seven days.

❖ **Week-**There are seven days in a week:- Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday. Each week begins on Monday according to the international standard ISO8601.

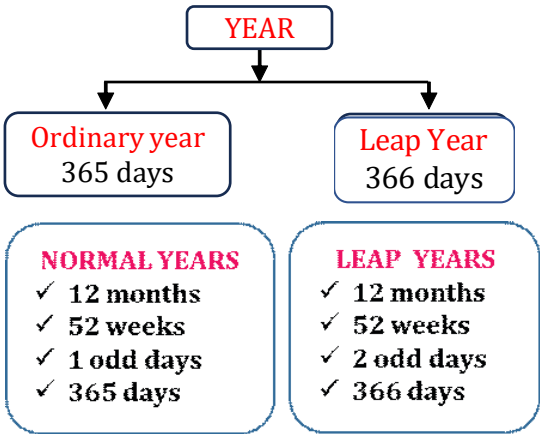
❖ **Month-** A month has 28/29/ 30/31 days. In this calendar 365 days (common year) is divided into 12 months of irregular lengths.

- 11 of the months have either 30 or 31 days while the second month **February has only 28/29 days.**
- These twelve months are **January, February, March, April, May, June, July, August, September, October, November and December.**
  - ✓ **January, March, May, July, August, October, December = 31 Days.**
  - ✓ **April, June, September, November = 30 days.**

❖ **Year:-** A year consists of **365 or 366 days.**

- There are **twelve months in a year**.
- There are **two kinds of a year.**

CALENDAR	
1 week	7 days
Normal year (1 year)	52 weeks + 1 odd days (extra day)
Leap year	52 weeks +2 odd days
Ordinary year	28th Feb
Leap year	29th Feb



REMEMBER THIS VERY IMPORTANT CODE					
CODE OF DAYS		CODE OF MONTH		CODE OF (CENTURY) YEAR	
Sunday	0	January	0	1500	0
Monday	1	February	3	1600	6
Tuesday	2	March	3	1700	4
Wednesday	3	April	6	1800	2
Thursday	4	May	1	1900	0
Friday	5	June	4	2000	6
Saturday	6	July	6		
		August	2		

➢ **From 1 January 2018 to 11 August 2018:**

January	31 days
February	28 days
March	31 days
April	30 days
May	31 days
June	30 days
July	31 days
August	11 days
Total =	**223 days**

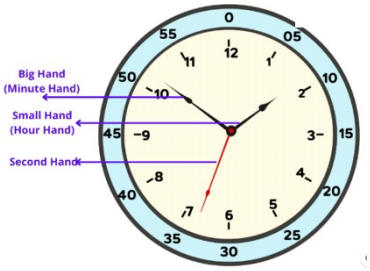
Total days in 2018:
= 223 days.

Step-02 Total number of days between 20 April 2017 and 11 August 2018:
255 days (2017) + 223 days (2018) = 478 days.
Step-03 Find the remainder when dividing by 7:
447÷7 = 68 weeks and **remainder 2**
So, there are 2 days between 20 April 2017 and 11 August 2018.
So, the day of the week on 20 April 2017 was **Thursday**

Monday
Tuesday
Wednesday
Thursday -1
Friday -1
Saturday
Sunday

Clock

- A clock is an instrument used for indicating and maintaining the time. It is an electronic device that presents the duration of an **hour, minute, and second.**
- A clock is a **complete circle having 360 degrees** where 1 hour is equivalent **60 minutes, 1 minute is equivalent to 60 seconds, and 1 hour is equivalent to 3600 seconds.**
- There are a total of 3 hands in a clock and these are **hour, minute, and second hand respectively.**



✓ **The Dial:** The Dial of a clock is circular in shape whose circumference is divided into **12 big divisions** labelled as **1, 2, 3, 12** and each 1 big division is divided into **5 equal divisions.**

✓ **Hour Hand:** The clock has mainly two hands of different length. The shorter hand of the clock is known as hour hand. The hour hand moves from one number to the next number in 1 hour. The hour hand takes 12 hours to complete one round. It takes **two complete rounds in a day**. Its direction of movement is known as **clockwise direction.**

✓ **Minute Hand:** The longer hand of the clock is known as minute hand. The minute hand also moves in clockwise direction. It moves from one small division to next division in 1 minute. The minute hand completes one round in 1 hour. We can say that minute hand covers 60 small divisions in one hour. **60min = 1 hour**

❖ **Types Of Clock Reasoning**

Angle Based Clock	• **The minute hand moves 360° in 60 minutes (1 hour).** • **Therefore, in 1 minute, the hand will produce a 6° angle.** • **This is because 360° divided by 60 equals 6°.**