ACADEMIC BOOK 2020-21

Semester I

Better Science, Better Health

LOKNETE DR. BALASAHEB VIKHE PATIL
(PADMA BHUSHAN AWARDEE)
PRAVARA RURAL EDUCATION SOCIETY'S

COLLEGE OF PHARMACY (FOR WOMEN)

NASHIK

College Code PH - 5201

Approved by A.I.C.T.E., New Delhi & Pharmacy Council of India, New Delhi
Affiliated to Savitribai Phule Pune University, Pune
Recognized by Govt. of Maharashtra

PHARMACIST'S OATH

I swear by the code of ethics of Pharmacy Council of India, in relation to the community and shall act as an integral part of health care team.

I shall uphold the laws and standards governing my profession.

I shall strive to perfect and enlarge my knowledge to contribute to the advancement of pharmacy and public health.

I shall follow the system which I consider best for Pharmaceutical care and counseling of patients.

I shall endeavor to discover and manufacture drugs of quality to alleviate sufferings of humanity.

I shall hold in confidence the knowledge gained about the patients in connection with my professional practice and never divulge unless compelled to do so by the law.

I shall associate with organizations having their objectives for betterment of the profession of Pharmacy and make contribution to carry out the work of those organizations.

While I continue to keep this oath unviolated, may it be granted to me to enjoy life and the practice of pharmacy respected by all, at all times!

Should I trespass and violate this oath, may the reverse be my lot!

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Vision

To emerge as the most preferred pharmacy educational institute with global recognition and developing competent and socially sensitive pharmacists committed to healthcare needs of society.

Mission

To develop students as global citizen with conscience,
commitment and dedication.

To create world class facilities and ambience for advanced level of
teaching, research and practical training.

To recruit and retain highly motivated and qualified faculty to promote the cause of teaching and learning.

Program Objectives (POs)

The Program Outcomes of Bachelor in Pharmacy course are:

1. **Pharmacy Knowledge:** An ability to acquire, demonstrate, core and basic knowledge of Pharmaceutical and Life Sciences
2. **Planning Abilities:** An ability to develop, implement, effectively plan and organize work using time management, resource management, delegation skills and organizational skills to achieve goals in specified timeline.
3. **Problem Analysis:** An ability to identify, analyze, interpret data and take appropriate decision to solve problems related to routine Pharmacy Practices by applying acquired knowledge.
4. **Modern Tool Usage:** An ability to understand, choose and utilize Modern techniques and computing tools for Pharmacy practices by considering constraints.
5. **Leadership Skills:** An understanding of pharmaceutical management principles and apply these to one's own work, as a member and leader in a team, to manage projects to facilitate improvement in social health and well being.
6. **Professional Identity:** An ability to recognize, analyze and communicate Pharmacy professional values as a healthcare promoter.
7. **Pharmaceutical Ethics:** An ability to understand and use professional, ethical, legal, social issues and responsibilities for well being of the society.
8. **Communication:** An ability to comprehend, write reports, present and document to communicate effectively for exchange of professional information to Pharmacy community and society.
9. **The Pharmacist and Society:** An ability to overcome the societal, health and legal problems by providing better pharmaceutical care relevant to the Pharmacy profession.
10. **Environment and Sustainability**: An ability to recognize the impact of the professional Pharmaceutical solutions in social and environmental circumstances for sustainable development.
11. **Life-Long Learning:** An ability to recognize the need to engage in continuous Professional development by taking in consideration timely feedback and technological changes for life long learning process.

Program Specific Outcomes (PSO)

Pharmacy Students are able to:

PSO 1: To build graduate to excel in technical or professional careers in various pharmaceutical industry and/ or institute and /or Health care system through rigorous education. Also analyze and communicate the skills, values of their professional roles in society.

PSO 2: To learn, select, apply appropriate methods, procedures, resources and modern pharmacy-related computing tools with an understanding of the limitations.

PSO 3: To operate, control, analyze and evaluate chemical substances and finished products also processes within permissible limits.

PSO 4: To design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, sustainability social, ethical, health, safety and manufacturability for humans.

ACADEMIC CALENDAR

(June 2020 - December 2020)

Semester: **All Semesters of B. Pharm and M. Pharm** Academic Year: **2020-2021**

Week No.	Month	Week Days							No. of Working Days	Events
		Mon	Tue	Wed	Thu	Fri	Sat	Sun		
1	May-20					1	2	3		May 6, 2020: Departmental academic meeting for workload finalization May 8, 2020: Distribution of final workload May 26, 2020: Submission of Academic book May 27, 2020: Preparation of new coarse files
2		4	5	6	7	8	9	10		
3		11	12	13	14	15	16	17		
4		18	19	20	21	22	23	24		
5		25	26	27	28	29	30	31		
6	Jun-20	1	2	3	4	5	6	7		June 5, 2020: Guide allotment for PG June 6, 2020: Celebration of World Environment Day June 15, 2020: Submission of Soft Copy of Manual First, second and final year June 15, 2020: Commencement of classes June 22, 2020: Submission of Soft Copy of Manual Third year June 21, 2020: International Yoga Day June 26, 2020: International Day against Drug Abuse& Rajamata Jijau Punyatithi, Shahu Maharaj Jayanti. June 29, 2020: Academic Review Meeting
7		8	9	10	11	12	13	14		
8		15	16	17	18	19	20	21	6	
9		22	23	24	25	26	27	28	6	
10		29	30						2	
11	Jul.-20			1	2	3	4	5		July 1, 2020: Doctors Day July 1-7, 2020: Plantation Week July 13, 2020: Industrial Visit (2nd Year B.Pharm) July 13, 2020: Field Visit (3rd Year B.Pharm) July 15, 2020: Selection of Research Topic (PG) presentation July 28, 2020: Academic Review Meeting July 29, 2020: World Hepatitis Day & Constitution of Anti Ragging World July 29, 2020: World Hepatitis Day & Constitution of AntiRagging Committee & Squad, Women Empowerment Committee formation, Student Grievance &Redressal committee. July 31, 2020: First Student Feedback (2nd to Final Year B.Pharm)
12		6	7	8	9	10	11	12	6	
13		13	14	15	16	17	18	19	6	
14		20	21	22	23	24	25	26	6	
15		27	28	29	30	31			5	
16	Aug.-20						1	2	0	August 1, 2020: Bakri Id August 3, 2020: Induction Program, Parent Meet & Commencement of classes

17		3	4	5	6	7	8	9	6
18		10	11	12	13	14	15	16	5
19		17	18	19	20	21	22	23	5
20		24	25	26	27	28	29	30	6
		31							
19	Sep-20		1	2	3	4	5	6	6
20		7	8	9	10	11	12	13	6
21		14	15	16	17	18	19	20	6
22		21	22	23	24	25	26	27	6
23		28	29	30					3
24	Oct-20				1	2	3	4	2
25		5	6	7	8	9	10	11	6
26		12	13	14	15	16	17	18	6

for first year.
August 5, 2020: Enrolment of students for NSS. 15 August, 2020: Independence Day
August 19, 2020: August 23, 2019: Industrial Visit (4th Year)
August 22, 2020: Ganesh Chaturti
August 24, 2020: M.Pharm Industrial Visit
August 24, 2020: Expert Lecture
August 26, 2020: Enrolment for earn and learn scheme
August 29, 2020: National Sports Day
August 29, 2020: Dhyanchand Jayanti
August 29, 2020: Muharram
August 31, 2020: Academic Review Meeting
August 31, 2020: Industrial Visit (3rd Year)
August 31, 2020: First students feedback (1st Year)
August 30 & 31, 2020: International Conference (Multitrack)
September 1, 2020: Ganesh Visarjan
September 3, 2020: Freshers Day & Inauguration of students Council
September 4-9, 2020: Practical sessional and CA exam (second, third, final year)
September 8-12, 2020: Theory sessional and CA exam (second, third, final year
September 5, 2020: Teachers Day
September 14, 2020: Expert Lecture
September 14, 2020: Hospital visit (First Year)
September 24, 2020: NSS Day & Blood donation Camp
September 25, 2020: World Pharmacist Day
September 28, 2020: Academic Review Meeting
September 28, 2020: Second students feedback (1st to Final Year)& Academic audit (Internal)
September 30, 2020: World Heart Day Rally
October 1, 2020: SwaccthaAbhiyan
October 2, 2020: Mahatma Gandhi Jayanti
October 5-10, 2020: Practical sessional and CA exam (first year UG, PG)
October 12-17, 2020: Theory sessional and CA exam (first year UG, PG)
October 5, 2020: KanyaRatnaAbhiyan (Inter Collegiate Debate competition)
October 10, 2020: World Mental Health day awareness seminar.
October 11, 2020: National Girl

27		19	20	21	22	23	24	25	5	Childs Day October 12, 2020: PG Specialisation presentation. October 12, 2020: Workshop on Competitive Examination October 28, 2020: Academic Review Meeting October 25, 2020: Dusshera October 30, 2020: Eid e milad
28		26	27	28	29	30	31			
29	Nov-20							1	0	November 2-7, 2020: Practical sessional and CA exam (UG, PG) November 9-14, 2020: Theory sessional and CA exam (UG, PG) November 14,2020: Diwali (Laxmi pujan) November 16, 2020: Diwali (Balipratipada) November 30, 2020: Gurunanak Jayanti
30		2	3	4	5	6	7	8	6	
31		9	10	11	12	13	14	15	5	
32		16	17	18	19	20	21	22	5	
33		23	24	25	26	27	28	29	6	
34		30							0	
35	Dec-20		1	2	3	4	5	6	5	December 2- 10, 2020: Semester Practical Examination December 10- 31: Sem Theory Exam December 16, 2020: Academic Meeting December 23, 2020: Submission of Timetable, Academic File (Timetable, Lesson Plan, Practical Plan etc)
36		7	8	9	10	11	12	13	6	
37		14	15	16	17	18	19	20	6	
38		21	22	23	24	25	26	27	5	
39		28	29	30	31				4	

Colour Index			
Working days with activity	Working teaching days	University Exam Days	Holidays
21	105	25	44

Course Structure
Course of study for semester I

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I-Theory	3	1	4
BP102T	Pharmaceutical Analysis I-Theory	3	1	4
BP103T	Pharmaceutics I-Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry (PIC)-Theory	3	1	4
BP105T	Communication skills – Theory *	2	-	2
BP106T	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology-Practical	4	-	2
BP108P	Pharmaceutical Analysis I-Practical	4	-	2
BP109P	Pharmaceutics I-Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry-Practical	4	-	2
BP111P	Communication skills-Practical*	2	-	1
BP112BP	Remedial Biology-Practical*	2	-	1
	Total	**28**	**4**	**24**

Schemes for internal assessments and end semester examinations semester wise

Course Code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP101T	Human Anatomy and Physiology I	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis I	10	15	1 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I	10	15	1 Hr	25	75	3 Hrs	100
BP104T	PIC	10	15	1 Hr	25	75	3 Hrs	100
BP105T	Communication skills*	5	10	4 Hrs	15	35	4 Hrs	50
BP106RBT BP106RMT	R. Biology/ R. Mathematics*	5	10	4 Hrs	15	35	4 Hrs	50
BP107P	Human Anatomy and Physiology I	5	10	4 Hrs	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I	5	10	4 Hrs	15	35	4 Hrs	50
BP109P	Pharmaceutics I	5	10	4 Hrs	15	35	4 Hrs	50
BP110P	PIC	5	10	4 Hrs	15	35	4 Hrs	50
BP111P	Communication skills*	5	5	2 Hrs	10	15	2 Hrs	25
BP112BP	Remedial Biology*	5	5	2 Hrs	10	15	2 Hrs	25
	Total	**60**	**100**	**20 Hrs**	**160**	**440**	**28 Hrs**	**600**

EVALUATION GUIDELINES

Scheme for Continuous mode (Theory): [Total: 10 Marks]

Criteria	Maximum Marks	
Attendance	4	2
Academic activities (Average of any 2 activities e.g. class test, quiz, assignment, open book test, field work, group discussion and seminar)	4	3
Student -Teacher interaction	2	
Total	10	05

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory
95 – 100	4
90 – 94	3
85 – 89	2
80 – 84	1
Less than 80	0

In-Semester Examination (Sessional): [Total: 15 Marks]

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college. The scheme of question paper is given below. The average marks of two Sessional exams shall be computed for internal assessment.

Paper pattern and marks distribution for In Semester Exam: As per university guideline

I. Objective Type Questions (Answer 5 out of 7) = 05 x 2 = 10
II. Long Answers (Answer 1 out of 2) = 1 x 10 = 10
II. Short Answers (Answer 2 out of 3) = 2 x 5 = 10

Total = 30 marks (1.5 Hrs)

Sessional exam shall be conducted for 30 marks for theory and shall be computed for 15 marks.

End Semester Examination [Total: 75 Marks]:

Paper pattern and marks distribution for End Semester Exam: As per university guideline

I. Objective Type Questions (Answer 5 out of 7) = 5 x 3 = 15
II. Long Answers (Answer 2 out of 4) = 2 x 10 = 20
II. Short Answers (Answer 8 out of 10) = 8 x 5 = 40

Total = 75 marks (3 hrs)

Subject I

HUMAN ANATOMY AND PHYSIOLOGY-I

(BP101T)

SCHEME

BP101T Human Anatomy and Physiology-I

SCHEME FOR TEACHING

Course of study for semester I

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP101T	HAP-I	03	-	01	04
BP107P	HAP-I	-	04	-	02

Schemes for internal assessments and end semester examinations

Course Code	Course Name	Internal Assessment				End Semester Exams		Total Marks
			Sessional Exams					
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP101T	HAP-I	10	15	1 Hrs	25	75	3 Hrs	100
BP107P	HAP-I	5	10	4 Hrs	15	35	4 Hrs	50

SYLLABUS

BP101T Human Anatomy and Physiology-I

Sr. No.	Topics	Hrs
This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy		
Unit I	**Introduction to human body** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **Cellular level of organization** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine **Tissue level of organization** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	10
Unit II	**Integumentary system** Structure and functions of skin **Skeletal system** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction **Joints** Structural and functional classification, types of joints movements and its articulation	10
Unit III	**Body fluids and blood** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system	10
Unit IV	**Peripheral nervous system**: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses** Structure and functions of eye, ear, nose and tongue and their disorders	08
Unit V	**Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart	07

Recommended Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 31
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.
9. Textbook of Pathology by Harshmohan, Jaypee brother's medical publishers, New Delhi.
10. Ross & Wilson Anatomy & Physiology in health & illness

Reference Books (Latest Editions)

R1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA

R2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.

R3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje , Academic Publishers Kolkata 32

LESSON PLAN

BP101T Human Anatomy & Physiology-I

Name of the faculty: Mr. Mayur T. Gaikar

Bloom Levels (BL): L1. Remember L2. Understand L3. Apply L4. Create						
Lecture No	**Description**	**Teaching Methodology**	**COs**	**POs**	**BL**	**References**
1	**Introduction to human body** Definition and scope of anatomy and physiology	chalk and talk	CO1	PO1	1	6
2	levels of structural organization and body systems,	chalk and talk	CO1	PO1	2	6
3	basic life processes, homeostasis, basic anatomical terminology	chalk and talk	CO1, CO2	PO1	2	6
4	**Cellular level of organization** Structure and functions of cell, transport across cell membrane	chalk and talk, Power Point Presentation	CO1	PO1	2	6
5	cell division, cell junctions. General principles of cell communication	chalk and talk, Power Point Presentation	CO1	PO1	2	4,6
6	intracellular signaling pathway activation by extracellular signal molecule,	chalk and talk, Power Point Presentation	CO1	PO1	2	
7	Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine	chalk and talk	CO1	PO1	2	4,6,10

8	**Tissue level of organization** Classification of tissues	chalk and talk, Power Point Presentation	CO1	PO1	2	6
9	structure, location and functions of epithelial, muscular	chalk and talk, Power Point Presentation	CO1	PO1	2	6
10	nervous and connective tissues	chalk and talk, Power Point Presentation	CO1	PO1	2	4,6
11	**Integumentary system** Structure of skin	chalk and talk, Power Point Presentation	CO1	PO1	2	6
12	functions of skin	chalk and talk, Power Point Presentation	CO1	PO1	2	6,24
13	**Skeletal system** Divisions of skeletal system	chalk and talk, Power Point Presentation		PO1	2	4,6,24
14	types of bone	chalk and talk, Power Point Presentation	CO3	PO1	2	6
15	salient features and functions of bones of axial skeletal system	chalk and talk, Power Point Presentation	CO1	PO1	2	6
16	salient features and	chalk and	CO1	PO1	2	6

	functions of bones of appendicular skeletal system	talk, Power Point Presentation				
17	salient features and functions of bones of appendicular skeletal system	chalk and talk, Power Point Presentation	CO1	PO1	2	6
18	Organization of skeletal muscle,	chalk and talk, Power Point Presentation	CO1	PO1	2	4,6
19	physiology of muscle contraction	chalk and talk	CO1	PO1	2	10,4
20	neuromuscular junction	chalk and talk	CO1	PO1	2	10,4
21	Body fluids, composition and functions of blood,	chalk and talk	CO1	PO1	2	4,6,10,24
22	hemopoeisis, formation of hemoglobin, anemia,	chalk and talk	CO1	PO1	2	4
23	mechanisms of coagulation, blood grouping	chalk and talk	CO2	PO1	2	4
24	Rh factors, transfusion, its significance	chalk and talk	CO1	PO1	2	4
25	disorders of blood,	chalk and talk	CO1	PO1	2	4
26	Reticulo endothelial system	chalk and talk	CO1	PO1	2	4,6
27	**Lymphatic system** Lymphatic organs and tissues	chalk and talk	CO1	PO1	2	4,6
28	lymphatic vessels,	chalk and talk	CO1	PO1	2	4,6
29	lymph circulation	chalk and talk	CO1	PO1	2	6,10
30	functions of lymphatic system	chalk and talk	CO1	PO1	2	4,6
31	Classification of peripheral	chalk and talk	CO1	PO1	2	10,24

	nervous system					
32	Structure and functions of sympathetic and parasympathetic nervous system	chalk and talk	CO1	PO1	2	6,10,24
33	Origin and functions of spinal	chalk and talk	CO1	PO1	2	4,6
34	Origin and functions of cranial nerves	chalk and talk		PO1	2	4,6
35	Structure and functions of eye and their disorders	chalk and talk, power point presentation2	CO1	PO1	2	4,6
36	Structure and functions of ear and their disorders	chalk and talk, power point presentation	CO1	PO1	2	4,6
37	Structure and functions of nose and their disorders	chalk and talk, power point presentation	CO1	PO1	2	4,6
38	Structure and functions of tongue and their disorders	chalk and talk, power point presentation	CO1	PO1	2	4,6
39	Heart – anatomy of heart, blood circulation	chalk and talk, power point presentation	CO1	PO1	2	4,6
40	blood vessels, structure and functions of artery, vein and capillaries	chalk and talk, power point presentation	CO1, CO1	PO1	2	4,6

41	elements of conduction system of heart and heart-beat, its regulation by autonomic nervous system	chalk and talk, power point presentation	CO1, CO2	PO1	2	4,6
42	cardiac output	chalk and talk	CO1, CO1	PO1	2	4,6
43	cardiac cycle	chalk and talk	CO1, CO2	PO1	2	4,6
44	Regulation of blood pressure, pulse	chalk and talk	CO1, CO2	PO1	2	4,6
45	electrocardiogram and disorders of heart	chalk and talk	CO1	PO1	2	4,6

COURSE DELIVERY, OBJECTIVES, OUTCOMES

BP101T Human Anatomy & Physiology-I

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon completion of this course the student should be able to

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the various experiments related to special senses and nervous system.
5. Appreciate coordinated working pattern of different organs of each system

Course Outcomes (COs):

After successful completion of course student will able to

CO 1	Recall **[L1: Remembering]** about the gross morphology, structure and functions of cell, skeletal, muscular, cardiovascular system of the human body.
CO 2	Classify **[L2: Understanding]** the various homeostatic mechanisms and their imbalances.
CO 3	Identify **[L1: Understanding]** the different types of bones in human body & various tissues of different systems of human body.
CO4	Apply about the various experimental techniques **[L3: Applying]** related to physiology learnt various techniques like blood group determination, blood pressure measurement, blood cells counting.

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	-	-	-	-	-	3	2	2	2	3
CO2	3	1	1	1	-	-	-	-	-	-	2	1	1	2	3
CO3	3	1	3	2	2	-	-	-	-	-	2	3	2	2	3
CO4	3	2	3	3	-	-	-	-	-	-	3	2	2	2	3
Average	3	1.25	2.25	1.75	2	-	-	-	-	-	2.5	2	1.75	2	3

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because it demonstrate the knowledge about life process of human body
CO1 with PO2	CO1 is aligned with PO2 because it deals to achieve specific goal within timeline
CO1 with PO3	CO1 is aligned with PO3 because it deals with the knowledge about to solve problems of our health & public health
CO1 with PO4	CO1 is aligned with PO4 because it deals with to use computing tools for research based knowledge
CO1 with PO5	CO1 is aligned with PO5 because it deals with the improvement of skills of individuals
CO1 with PO11	CO1 is aligned with PO11 because it deals with to understood the knowledge about human system
CO2 with PO1	CO2 is aligned with PO1 because it moderately deals with the basic knowledge related to human health
CO2 with PO2	CO2 is aligned with PO2 because it deals to achieve specific goal within timeline
CO2 with PO3	CO2 is aligned with PO3 because analysis of simple knowledge about process to meet desired need for solving problems of new process.
CO2 with PO4	CO2 is aligned with PO4 because through the analysis one can interpret the data and identify the multicomponent of the substances
CO2 with PO11	CO2 is aligned with PO11 because it deals with to study about various homeostatic mechanism involved in our body
CO3 with PO1	CO3 is aligned with PO1 because of knowledge of life process needed in pharmaceutical sciences
CO3 with PO2	CO3 is aligned with PO2 because to perform data within specific time period
CO3 with PO3	CO3 is aligned with PO2 because it perform process under consideration of solving problem
CO3 with PO4	CO3 is aligned with PO4 because it deals with the design computational model for understanding body parts.
CO3 with PO11	CO3 is aligned with PO11 because it deals with to study the various types of bones.

CO3 with PO5	CO3 is aligned with PO5 because it deals with to achieve work related to skills.
CO4 with PO1	CO4 is aligned with PO1 because it demonstrate the knowledge about life process of human body
CO4 with PO2	CO4 is aligned with PO2 because it deals with to perform experiment on time basis
CO4 with PO3	CO4 is aligned with PO3 because it deals with to analyse data using practical model
CO4 with PO4	CO4 is aligned with PO4 because it deals with to analyse our health in consideration of modern tools
CO4 with PO11	CO4 is aligned with PO11 because it deals with to study the various haematological parameter & they are also helpful for society
CO1 with PSO1,2,3,4	Student applies fundamental knowledge to learn, build, operate and design in pharmaceutical industry by having the knowledge of gross morphology, structure and functions of cell, skeletal, muscular, cardiovascular & Nervous system of the human body
CO2 with PSO1,2,3,4	Student applies fundamental knowledge to learn, build, operate and design in pharmaceutical industry by having the knowledge of homeostatic mechanisms and their imbalances
CO3 with PSO1,2,3,4	Student applies fundamental knowledge to learn, build, operate and design in pharmaceutical industry by having the knowledge of types of bones in human body
CO4 with PSO1,2,3,4	Student applies fundamental knowledge to learn, build, operate and design in pharmaceutical industry by having the knowledge of various techniques like blood group determination, blood pressure measurement, blood cells counting

QUESTION BANK

BP101T Human Anatomy & Physiology-I

Sr. No	Questions	CO mapped	Bloom level
Q.1	Explain the scope of anatomy & physiology	CO1	2
Q.2	What are the levels of structural organization & body system?	CO1	2
Q.3	Describe in detail structure & functions of cell membrane	CO1	1
Q.4	Explain the transport mechanism across the cell membrane?	CO2	3
Q.5	Explain the process of cell division?	CO1	2
Q.6	What are the general principles of cell communications	CO1	2
Q.7	Describe in detail intracellular signalling pathway activation by extracellular signal molecule	CO1	3
Q.8	Enlist various forms of intracellular signalling	CO1	2
Q.9	Explain a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine forms of intracellular signalling	CO1	2
Q.10	Write down the classification of tissues	CO3	3
Q.11	Explain the structure, location and functions of epithelial & muscular cell	CO1	3
Q.12	Explain the structure, location and functions of nervous and connective tissues	CO3	3
Q.13	Describe in detail Structure & functions of skin	CO1	3
Q.14	Write a note on divisions of skeletal system	CO3	3
Q.15	Enlist the types of bone	CO3	3
Q.16	Explain the salient features and functions of bones of axial skeletal system	CO3	3
Q.17	Describe in detail salient features and functions of bones of appendicular skeletal system	CO3	3
Q.18	Explain the organization of skeletal muscle?	CO3	2
Q.19	Describe the physiology of muscle contraction & neuromuscular junction	CO2	3
Q.20	Explain Organization of neuron & Neuroglia?	CO2	3
Q.21	What are the properties of nerve fibre?	CO1	1
Q.22	Explain the terms electrophysiology, action potential & nerve impulse	CO1	2
Q.23	Explain the structure & functions of brain	CO1	3
Q.24	Explain functions of afferent and efferent nerve tracts &reflex activity	CO1	3
Q.25	Write down the Classification of peripheral nervous system?	CO1	2
Q.26	Explain Structure and functions of sympathetic and parasympathetic nervous system?	CO1	3
Q.27	What are Origin and functions of cranial nerves?	CO1	1

Q.28	Explain Structure and functions of eye and their disorders?	CO1	2
Q.29	Explain conduction system of heart?	CO3	3
Q.30	Explain anatomy of heart?	CO2	3
Q.31	Explain regulation process of blood pressure?	CO2	3
Q.32	Explain the terms cardiac output & cardiac cycle?	CO1	2
Q.33	Explain the terms ECG?	CO2	3
Q.34	Write a short note on hypertension, atherosclerosis?	CO1	3
Q.35	What is mean by cardiac output & heart rate?	CO3	3

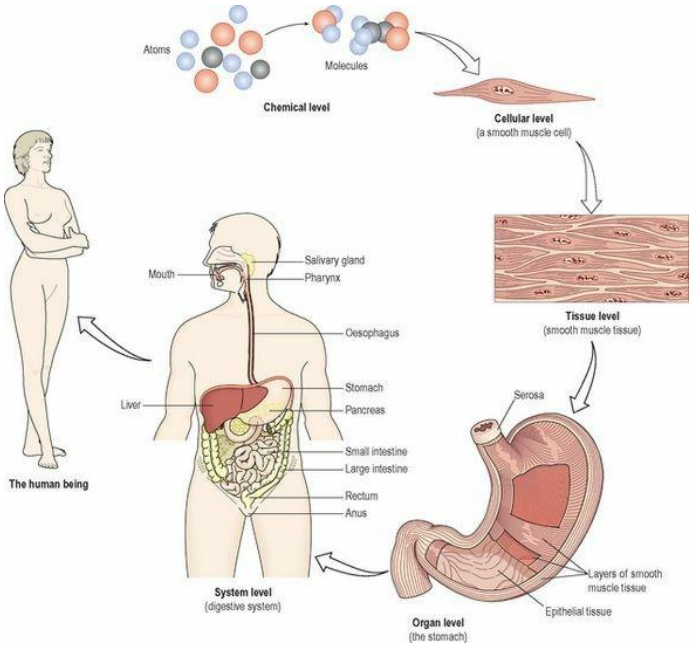
Model Answers

1. Define & explain the scope of anatomy & physiology?

Ans. *Anatomy* is the study of the structure of the body and the physical relationships between body systems. *Physiology* is the study of how the body systems work, and the ways in which their integrated activities maintain life and health of the individual.

2. What are the levels of structural organization & body system?

Ans.



Within the body are different levels of structural organisation and complexity. The most fundamental level is chemical. *Atoms* combine to form *molecules*, of which there are vast ranges in the body. *Cells* are the smallest independent units of living matter and there are trillions of them within the body. They are too small to be seen with the naked eye, but when magnified using a microscope different types can be distinguished by their size, shape and the dyes they absorb when stained in the laboratory. Each cell type has become *specialised*, and carries out a particular function that contributes to body needs. Figure shows some highly magnified nerve cells. In complex organisms such as the human body, cells with similar structures and functions are found together, forming *tissues*.

Organs are made up of a number of different types of tissue and have evolved to carry out a specific function. Figure shows that the stomach is lined by a layer of epithelial tissue and that its wall contains layers of smooth muscle tissue. Both tissues contribute to the functions of the stomach, but in different ways.

Systems consist of a number of organs and tissues that together contribute to one or more survival needs of the body. For example the stomach is one of several organs of the digestive system, which has its own specific function. The human body has several systems, which work interdependently carrying out specific functions. All are required for health.

3. Explain different basic life process of human body?

Ans. Human body performs different physiological functions for its survival & reproduction, which are the ultimate goals of a living organism. To achieve these goals, the body maintains & restores the homeostasis.

Basic life process as follows:

1) Organisation: at all organizational levels of the body, each component works to perform it own function in coordination with the other component. However, if a single cell does not cooperate with the other cells, then it loses its integrity, & becomes dead.

2) Metabolism: Divided in two phases, i.e. catabolism & anabolism. In catabolism, the macro or complex molecules are broken down into micro or simpler substances with simultaneous release of energy, whereas, anabolism is the process of construction involving formation of complex molecules by simpler molecules.

3) Responsiveness: irritability or responsiveness identifies the internal or external environment changes, & thereby react to it. It occurs in response to any stimulus experienced by sensory nerves & thereafter response to it.

4) Movement: Different types of movements are performed inside the body at each organizational level. E.g. movement of molecules from one place to another place at cellular level, movement of blood from one part of the body to other part, movement of diaphragm with every breath during the process of respiration. The muscle fibres possess the ability to contract thus producing a movement known as contractility.

5) Reproduction: Is the process of formation of new cells for the replacement & repair of old cells. It also promotes growth of newly formed cells.

6) Growth: Is recognized as increase in size either by increasing the number of cells or their size. For promoting growth anabolic process must proceed at a faster rate than the catabolic process.

7) Differentiation: Is the process of development in which cells get specialized either functionally, structurally or by both. Later following differentiation, the cells develop in to tissues and organs.

8) Respiration: All the internal & external process engaged in the gaseous exchange is together termed as respiration. The external respiration includes ventilation, diffusion of oxygen & co2 and transport of gases within the blood circulation. Respiration at cellular level is the catabolic process, involving combustion of glucose in the presence of o2 within the cell, and release of ATP, water and CO2.

9) Digestion: Involves degradation of macromolecules in to micro molecules & their absorption in the blood. These molecules absorbed in to the circulation for further utilization.

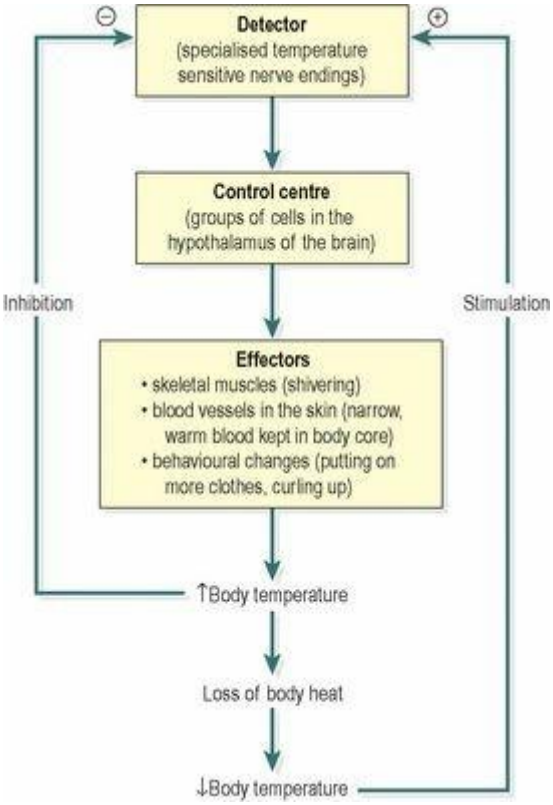
10) Excretion: The process of removal of waste products from the body is known as excretion. The by-products which cannot be used up are excreted out of the body.

4. What is mean by homeostasis & explain negative feedback mechanism?

Ans. The composition of the internal environment is tightly controlled, and this fairly constant state is called *homeostasis*. Literally, this term means ‘unchanging’, but in practice it describes a dynamic, ever-changing situation kept within narrow limits. When this balance is threatened or lost, there is a serious risk to the well-being of the individual.

Examples of physiological variables:
Core temperature
Water and electrolyte concentrations
pH (acidity or alkalinity) of body fluids
Blood glucose levels
Blood and tissue oxygen and carbon dioxide levels
Blood pressure

Homeostasis is maintained by control systems that detect and respond to changes in the internal environment. A control system has three basic components: detector, control centre and effector. The *control centre* determines the limits within which the variable factor should be maintained. It receives an input from the *detector*, or sensor, and integrates the incoming information. When the incoming signal indicates that an adjustment is needed, the control centre responds and its output to the *effector* is changed. This is a dynamic process that allows constant readjustment of many physiological variables.



Example of a negative feedback mechanism: control of room temperature by a domestic boiler

Negative feedback mechanisms:

In systems controlled by negative feedback, the effector response decreases or negates the effect of the original stimulus, maintaining or restoring homeostasis (thus the term negative feedback). Control of body temperature is similar to the non-physiological example of a domestic central heating system. The thermostat (temperature detector) is sensitive to changes in room temperature (variable factor). The thermostat is connected to the boiler control unit (control centre), which controls the boiler (effector). The

thermostat constantly compares the information from the detector with the preset temperature and, when necessary, adjustments are made to alter the room temperature. When the thermostat detects the room temperature is low, it switches the boiler on. The result is output of heat by the boiler, warming the room. When the preset temperature is reached, the system is reversed. The thermostat detects the higher room temperature and turns the boiler off. Heat production from the boiler stops and the room slowly cools as heat is lost. This series of events is a negative feedback mechanism and it enables continuous self-regulation, or control, of a variable factor within a narrow range.

Body temperature is a physiological variable controlled by negative feedback, which prevents problems due to it becoming too high or too low. When body temperature falls below the preset level, this is detected by specialised temperature sensitive nerve endings in the hypothalamus of the brain, which form the control centre. This centre then activates mechanisms that raise body temperature (effectors). These include: stimulation of skeletal muscles causing shivering narrowing of the blood vessels in the skin reducing the blood flow to, and heat loss from, the peripheries behavioural changes, e.g. we put on more clothes or curl up.

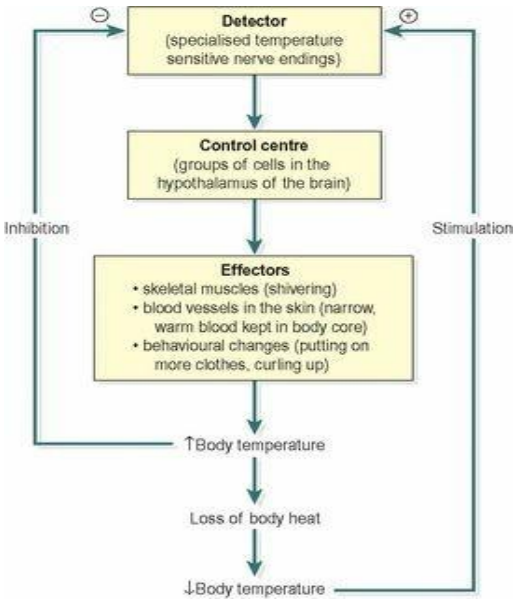


Figure: Example of a physiological negative feedback mechanism: control of body temperature.

When body temperature rises within the normal range again, the temperature sensitive nerve endings are no longer stimulated, and their signals to the hypothalamus stop. Therefore, shivering stops and blood flow to the peripheries returns to normal. Most of the homeostatic controls in the body use negative feedback mechanisms to prevent sudden and serious changes in the internal environment. Many more of these are explained in the following chapters.

Positive feedback mechanisms: There are only a few of these cascade or amplifier systems in the body. In positive feedback mechanisms, the stimulus progressively increases the response, so that as long as the stimulus is continued the response is progressively amplified. Examples include blood clotting and uterine contractions during labour. During labour, contractions of the uterus are stimulated by the hormone oxytocin. These force the baby's head into the cervix of the uterus, stimulating stretch receptors there. In response to this, more oxytocin is released, further strengthening the contractions and maintaining labour. After the baby is born the stimulus (stretching of the cervix) is no longer present so the release of oxytocin stops.
Homeostatic imbalance: This arises when the fine control of a factor in the internal environment is inadequate and the level of the factor falls outside the normal range. If the control system cannot maintain homeostasis, an abnormal state develops that may threaten health, or even life.

5. Define: Superior, Prone position, Supine position, Sagittal plane, coronal plane?

Ans. Superior: As the end of the head lies in the uppermost position, therefore it is known as superior end of the extremity.
Prone position: Face focusing downwards or towards the ground is known as prone position.
Supine position: Face is towards the upper side (roof) while back faces downwards
Saggital plane: From top to the down, an imaginary line slicing the body (from head to toes) in to two halves with erratic proportion is drawn.
Coronal plane: It divides the body from anterior (front) and posterior (back) portion, by passing through the body at right angle to the medial system.

6. **Describe in detail structure & functions of cell membrane?**

Ans: The human body develops from a single cell called the zygote, which results from the fusion of the ovum (female egg cell) and the spermatozoon (male sex cell). Cell division follows and, as the fetus grows, cells with different structural and functional specialisations develop, all with the same genetic make-up as the zygote. Individual cells are too small to be seen with the naked eye. However, they can be seen when thin slices of tissue are stained in the laboratory and magnified by a microscope. A cell consists of a plasma membrane inside which are a number of organelles suspended in a watery fluid called cytoplasm. Organelles, literally 'small organs', have individual and highly specialised functions, and are often enclosed in their own membrane within the cytoplasm. They include: the nucleus, mitochondria, ribosomes, endoplasmic reticulum, Golgi apparatus, lysosomes and the cytoskeleton.

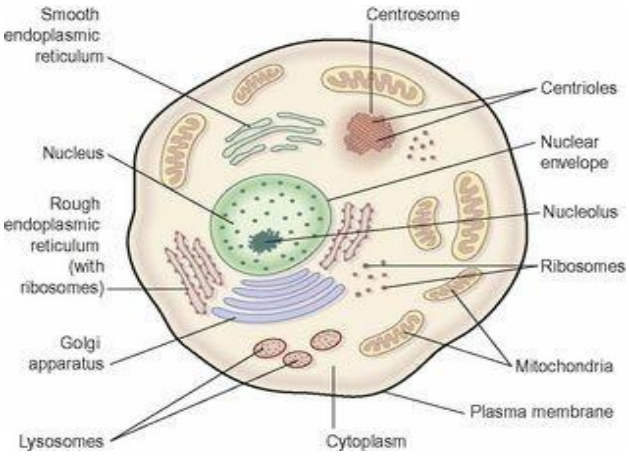


Figure: The simple cell

Plasma membrane

The plasma membrane consists of two layers of *phospholipids* with protein and sugar molecules embedded in them. In addition to phospholipids, the lipid *cholesterol* is also present in the plasma membrane. Those proteins that extend all the way through the membrane may provide channels that allow the passage of, for example, electrolytes and non-lipidsoluble substances. Protein molecules on the surface of the plasma membrane are shown in Figure.

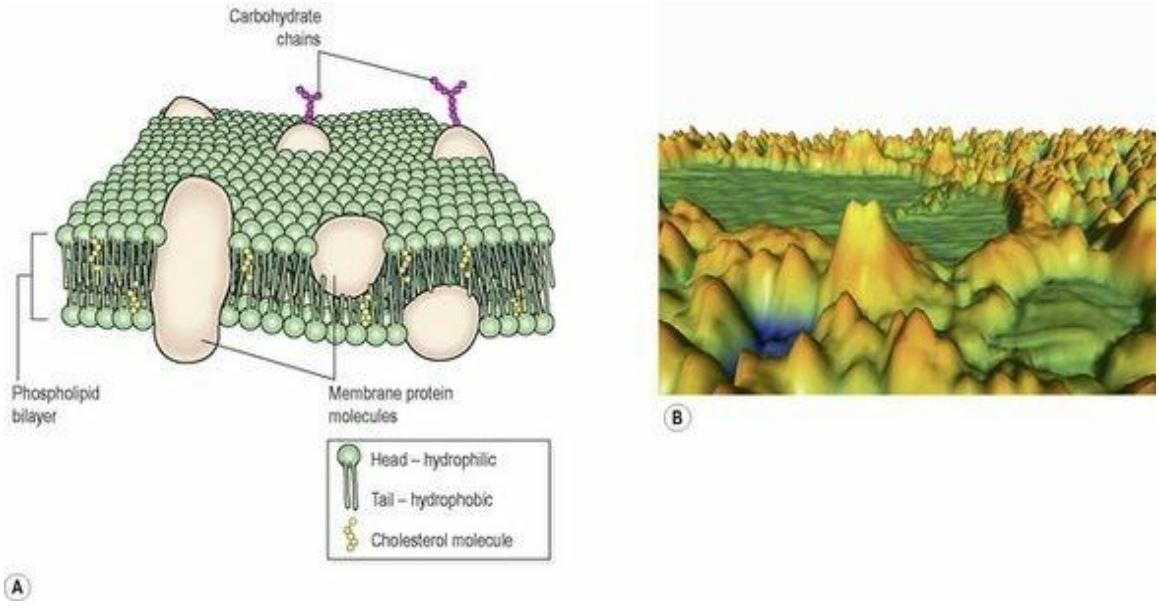


Figure: The plasma membrane. A. Diagram showing structure. **B.** Coloured atomic force micrograph of the surface showing plasma proteins.

The phospholipid molecules have a head, which is electrically charged and *hydrophilic* (meaning 'water loving'), and a tail which has no charge and is *hydrophobic* (meaning 'water hating',Fig.A). The phospholipid bilayer is arranged like a sandwich with the hydrophilic heads aligned on the outer surfaces of the membrane and the hydrophobic

tails forming a central water-repelling layer. These differences influence the transfer of substances across the membrane.

The membrane proteins perform several functions: branched carbohydrate molecules attached to the outside of some membrane protein molecules give the cell its immunological identity they can act as specific receptors (recognition sites) for hormones and other chemical messengers some are enzymes some are involved in transport across the membrane.

Organelles

Nucleus: Every cell in the body has a nucleus, with the exception of mature erythrocytes (red blood cells). Skeletal muscle and some other cells contain several nuclei. The nucleus is the largest organelle and is contained within the nuclear envelope, a membrane similar to the plasma membrane but with tiny pores through which some substances can pass between it and the *cytoplasm*, i.e. the cell contents excluding the nucleus. The nucleus contains the body's genetic material, which directs all the metabolic activities of the cell. This consists of 46m *chromosomes*, which are made from deoxyribonucleic acid (DNA). Except during cell division, the chromosomes resemble a fine network of threads called *chromatin*. Within the nucleus is a roughly spherical structure called the *nucleolus*, which is involved in manufacture (synthesis) and assembly of the components of ribosomes.

Mitochondria: Mitochondria are membranous, sausage-shaped structures in the cytoplasm, sometimes described as the 'power house' of the cell (Fig). They are involved in aerobic respiration, the processes by which chemical energy is made available in the cell. This is in the form of ATP, which releases energy when the cell breaks it down. Synthesis of ATP is most efficient in the final stages of aerobic respiration, a process requiring oxygen. The most active cell types have the greatest number of mitochondria, e.g. liver, muscle and spermatozoa.

Ribosomes: These are tiny granules composed of RNA and protein. They synthesise proteins from amino acids,

using RNA as the template. When present in free units or in small clusters in the cytoplasm, the ribosomes make proteins for use within the cell. These include the enzymes required for metabolism. Metabolic pathways consist of a series of steps, each driven by a specific enzyme. Ribosomes are also found on the outer surface of the nuclear envelope and rough endoplasmic reticulum (see Fig. 3.3 and below) where they manufacture proteins for export from the cell.

Endoplasmic reticulum (ER): Endoplasmic reticulum is an extensive series of interconnecting membranous canals in the cytoplasm (Fig. 3.3). There are two types: smooth and rough. Smooth ER synthesises lipids and steroid hormones, and is also associated with the detoxification of some drugs. Some of the lipids are used to replace and repair the plasma membrane and membranes of organelles. Rough ER is studded with ribosomes. These are the site of synthesis of proteins, some of which are 'exported' from cells, i.e. enzymes and hormones that leave the parent cell by exocytosis to be used by cells elsewhere.

Golgi apparatus: The Golgi apparatus consists of stacks of closely folded flattened membranous sacs (Fig. 3.4). It is present in all cells but is larger in those that synthesise

and export proteins. The proteins move from the endoplasmic reticulum to the Golgi apparatus where they are 'packaged' into membrane-bound vesicles called *secretory granules*. The vesicles are stored and, when needed, they move to the plasma membrane and fuse with it. The contents then leave the cell by exocytosis.

Lysosomes: Lysosomes are one type of secretory vesicle with membranous walls, which are formed by the Golgi apparatus. They contain a variety of enzymes involved in breaking down fragments of organelles and large molecules (e.g. RNA, DNA, carbohydrates, proteins) inside the cell into smaller particles that are either recycled or extruded from the cell as waste material. Lysosomes in white blood cells contain enzymes that digest foreign material such as microbes.

7. Explain the transport mechanism across the cell membrane?

Ans: The structure of the plasma membrane provides it with the property of *selective permeability*, meaning that not all substances can cross it. Those that can, do so in different ways depending on their size and characteristics.

Passive transport: This occurs when substances can cross the semipermeable plasma and organelle membranes and move down the concentration gradient (downhill) without using energy.

Diffusion: This was described on page 25. Small molecules diffuse down the concentration gradient: lipid-soluble materials, e.g. oxygen, carbon dioxide, fatty acids and steroids, cross the membrane by dissolving in the lipid part of the membrane water-soluble materials, e.g. sodium, potassium and calcium, cross the membrane by passing through water-filled channels.

Facilitated diffusion: This passive process is used by some substances that are unable to diffuse through the semipermeable membrane unaided, e.g. glucose, amino acids. Specialised protein carrier molecules in the membrane

have specific sites that attract and bind substances to be transferred, like a lock and key mechanism. The carrier then changes its shape and deposits the substance on the other side of the membrane. The carrier sites are specific and can be used by only one substance. As there are a finite number of carriers, there is a limit to the amount of a substance which can be transported at any time. This is known as the *transport maximum*.

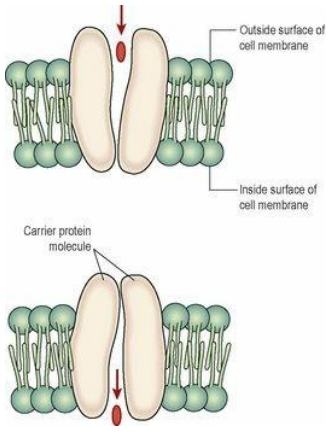


Figure 3.10 Specialised protein carrier molecules involved in facilitated diffusion and active transport.

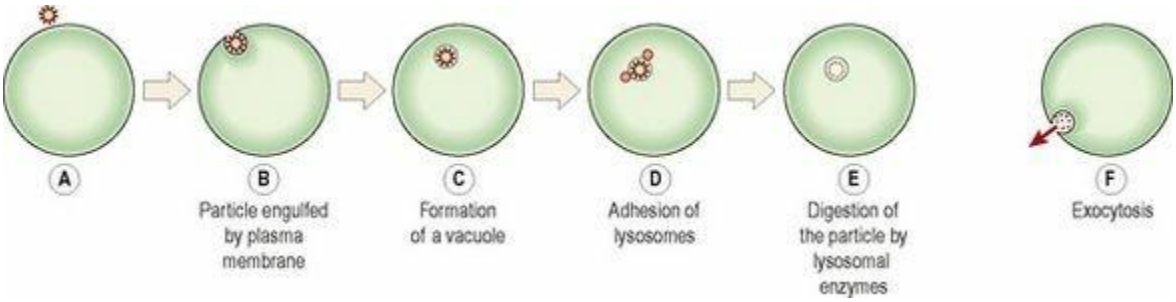
Osmosis: Osmosis is passive movement of water down its concentration gradient towards equilibrium across a semipermeable membrane.

Active transport: This is the transport of substances up their concentration gradient (uphill), i.e. from a lower to a higher concentration. Chemical energy in the form of ATP drives specialised protein carrier molecules that transport substances across the membrane in either direction (see Fig. 3.10). The carrier sites are specific and can be used by only one substance; therefore the rate at which a substance is transferred depends on the number of sites available.

The sodium–potassium pump: This active transport mechanism maintains the unequal concentrations of sodium (Na^+) and potassium (K^+) ions on either side of the plasma membrane. It may use up to 30% of cellular ATP requirements. Potassium levels are much higher inside the cell than outside – it is the principal intracellular cation. Sodium levels are much higher outside the cell than inside – it is the principal extracellular cation. These ions tend to diffuse down their concentration gradients, K^+ outwards and Na^+ into the cell. In order to maintain their concentration gradients, excess Na^+ is constantly pumped out across the cell membrane in exchange for K^+.

Bulk transport (Fig. 3.11): Transfer of particles too large to cross cell membranes occurs by *pinocytosis* or *phagocytosis*. These particles are engulfed by extensions of the cytoplasm which enclose them, forming a membrane-bound vacuole. When the vacuole is small, pinocytosis occurs. In phagocytosis

larger particles (e.g. cell fragments, foreign materials, microbes) are taken into the cell. Lysosomes



then adhere to the vacuole membrane, releasing enzymes which digest the contents.

Figure 3.11 Bulk transport across plasma membranes: A–E. Phagocytosis. **F.** Exocytosis.

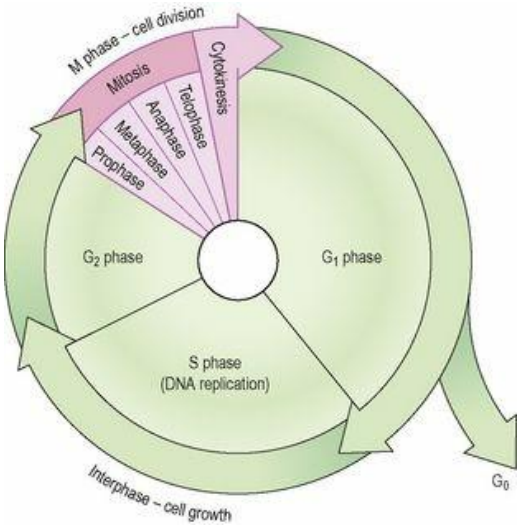
Export of waste material by the reverse process through the plasma membrane is called *exocytosis*. Secretory granules formed by the Golgi apparatus usually leave the cell in this way, as do any indigestible residues of phagocytosis.

8. Explain the process of cell division?

Ans. Most body cells are capable of division, even in adulthood. Cell division usually leads to production of two identical diploid daughter cells, *mitosis* and is important in body growth and repair. Production of gametes is different in that the daughter cells have only half the normal chromosome number – 23 instead of 46, i.e. they are haploid. Gametes are produced by a form of cell division called *meiosis*. DNA replication takes place before mitosis and meiosis.

DNA replication: DNA is the only biological molecule capable of self-replication. Mistakes in copying may lead to production of non-functioning or poorly functional cells, or cells that do not respond to normal cell controls (this could lead to the development of a tumour). Accurate copying of DNA is therefore essential. The initial step in DNA replication is the unfolding of the double helix and the unzipping of the two strands to expose the bases, as happens in transcription. Both strands of the parent DNA molecule are copied. The enzyme responsible for DNA replication moves along the base sequence on each strand, reading the genetic code and adding the complementary base to the newly forming chain. This means that each strand of opened bases becomes a double strand and the end result is two identical DNA molecules (Fig. 17.7). As each new double strand is formed, other enzymes cause it to twist and coil back into its normal highly folded form.Many damaged, dead, and worn out cells can be replaced by growth and division of other similar cells. Most body cells have 46 chromosomes and divide by mitosis, a process that results in two new genetically identical daughter cells. The only exception to this is the formation of gametes (sex cells), i.e. ova and spermatozoa, which takes place by meiosis.The period between two cell divisions is known as the cell cycle, which has two phases that can be seen on light microscopy: mitosis (M phase) and interphase (Fig. 3.7).

Figure 3.7 The cell cycle.



Mitosis:

Interphase: This is the longer phase and three separate stages are recognised:

first gap phase (G_1) – the cell grows in size and volume. This is usually the longest phase and most variable in length. Sometimes cells do not continue round the cell cycle but enter a resting phase instead (G_0).

synthesis of DNA (S phase) – the chromosomes replicate forming two identical copies of DNA (see p. 432). Therefore, following the S phase, the cell now has 92 chromosomes, i.e. enough DNA for two cells and is nearly ready to divide by mitosis.

Second gap phase – (G_2) there is further growth and preparation for cell division. Mitosis (Figs 3.8 and 3.9) 3.2

This is a continuous process involving four distinct stages seen by light microscopy.

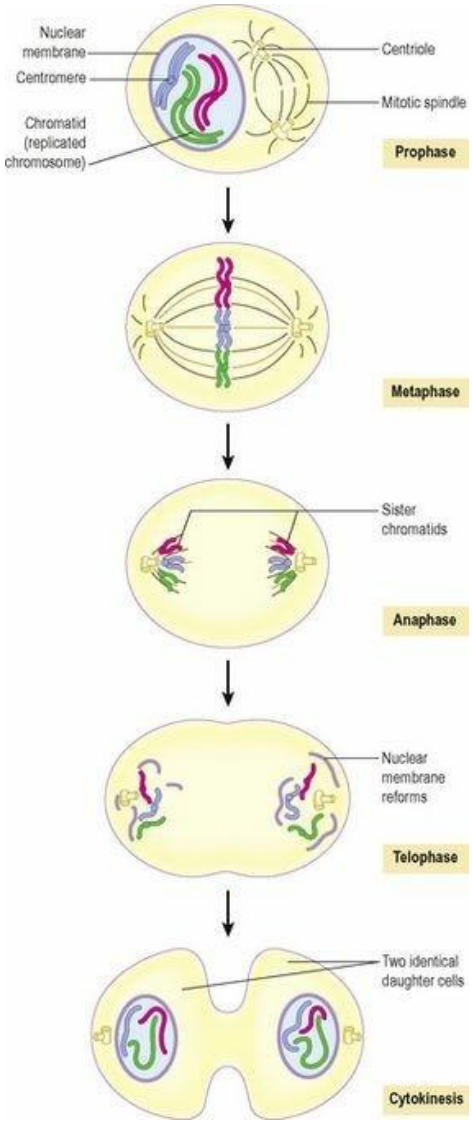


Figure 3.8 The stages of mitosis.

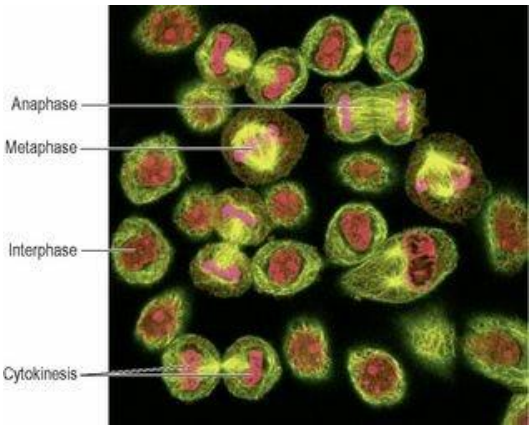


Figure 3.9Mitosis. Light micrograph showing cells at different stages of reproduction with chromatin/chromatids shown in pink.

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* (Fig. 3.8). The *mitotic apparatus* appears; this consists of two *centrioles* separated by the *mitotic spindle*, which is formed from microtubules. The centrioles migrate, one to each end of the cell, and the nuclear envelope disappears.

Metaphase:The chromatids align on the centre of the spindle, attached by their centromeres.

Anaphase: The centromeres separate, and one of each pair of sister chromatids (now called chromosomes again) migrates to each end of the spindle as the microtubules that form the mitotic spindle contract.

Telophase: The mitotic spindle disappears, the chromosomes uncoil and the nuclear envelope reforms. Following telophase, *cytokinesis* occurs: the cytoplasm, intracellular organelles and plasma membrane split forming two identical daughter cells. The organelles of the daughter cells are incomplete at the end of cell division but they develop during interphase. The frequency with which cell division occurs varies with different types of cell.

Meiosis: Meiosis produces gametes. On fertilisation, when the male gamete (sperm cell) and the female gamete (ovum) unite, the resulting zygote is diploid, because each gamete was haploid.Unlike mitosis, meiosis involves two distinct cell divisions rather than one (Fig. 17.8). Additionally, meiosis produces four daughter cells, not two, all different from the parent cells and from each other. This is the basis of genetic diversity and the uniqueness of each human individual.

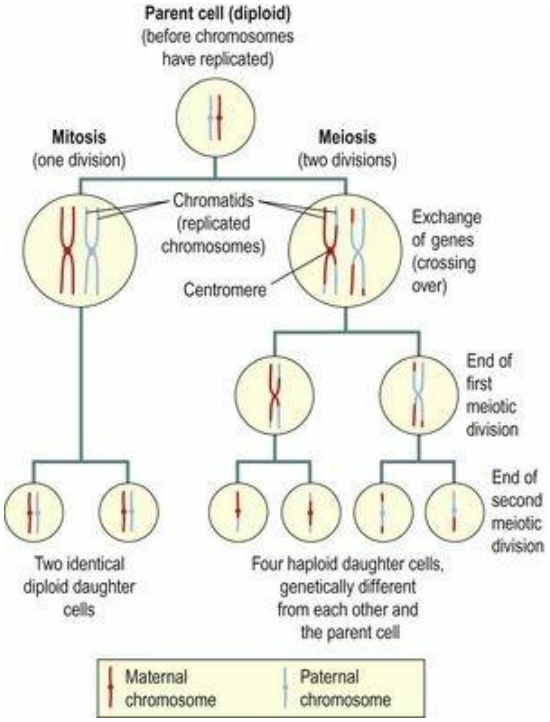


Figure 17.8 Mitosis and meiosis, showing only one pair of chromosomes for clarity.

First meiotic division: This stage (Fig. 17.8) produces two genetically different daughter cells. DNA replication occurred beforehand, so each pair of chromosomes is now four chromatids, and they gather together into a tight bundle. Because the chromosomes are so tightly associated, it is possible for them to exchange genes. This process is called *crossing over* 17.6, and results in the four chromatids acquiring different combinations of genes. Following crossing over, the pairs of chromosomes then separate in preparation for the first meiotic division, and transfer of maternal and paternal chromosomes to either daughter cell is random. This means that the two daughter cells have an unpredictable assortment of maternal and paternal DNA, giving rise to a huge number of possible combinations of chromosomes in them. This explains why a child inherits a combination of its mother's and father's characteristics. Each pair of chromosomes separates and one travels to each end of the cell, guided by a spindle as in mitosis, and the cytoplasm divides, producing two genetically unique diploid daughter cells.

Second meiotic division: For a gamete to be produced, the amount of genetic material present in the two daughter cells following the first meiotic division must be halved. This is accomplished by a second division (Fig. 17.8). The centromeres separate and the two sister chromatids travel to opposite ends of the cell, which then divides. Each of the four haploid daughter cells now has only one chromosome from each original pair. Fusion with another gamete creates a zygote (fertilised ovum), a diploid cell which can then go on to grow and develop into a human being by mitosis.

9.Write down the classification of tissues?

Ans. The tissues of the body consist of large numbers of cells and they are classified according to the size, shape and functions of these cells. There are four main types of tissue that each have subdivisions.

Epithelial tissue or epithelium, Connective tissue, Muscle tissue, Nervous tissue.

10.Explain the structure, location and functions of epithelial?

Ans. Epithelial tissue (Fig. 3.12): This group of tissues is found covering the body and lining cavities, hollow organs and tubes. It is also found in glands. The structure of epithelium is closely related to its functions, which include: protection of underlying structures from, for example, dehydration, chemical and mechanical damage Secretion absorption.

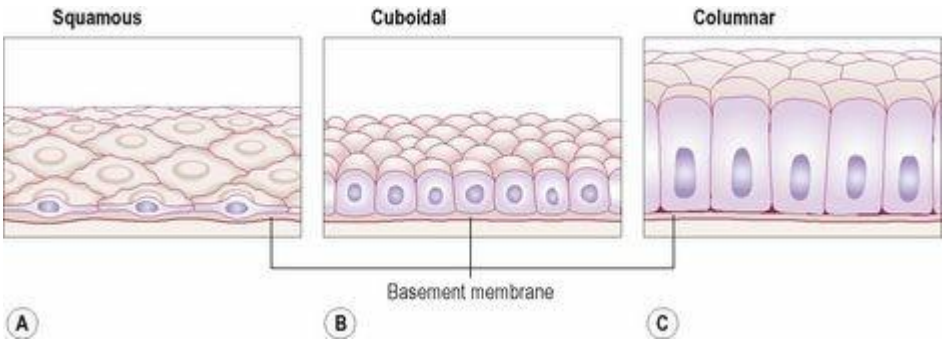


Figure 3.12 Simple epithelium. A. Squamous. **B.** Cuboidal. **C.** Columnar.

The cells are very closely packed and the intercellular substance, called the *matrix*, is minimal. The cells usually lie on a *basement membrane*, which is an inert connective tissue made by the epithelial cells themselves. Epithelial tissue may be:
simple: a single layer of cells
stratified: several layers of cells.

Simple epithelium: Simple epithelium consists of a single layer of identical cells and is divided into three main types. It is usually found on absorptive or secretory surfaces, where the single layer enhances these processes, and not usually on surfaces subject to stress. The types are named according to the shape of the cells, which differs according to their functions. The more active the tissue, the taller the cells.

Squamous (pavement) epithelium: This is composed of a single layer of flattened cells (Fig. 3.12A). The cells fit closely together like flat stones, forming a thin and very smooth membrane across which diffusion easily occurs. It forms the lining of the following structures: heart – where it is known as endocardium alveoli of the lungs lining the collecting ducts of nephrons in the kidneys (see Fig. 13.9, p. 333).

Cuboidal epithelium: This consists of cube-shaped cells fitting closely together lying on a basement membrane (Fig. 3.12B). It forms the kidney tubules and is found in some glands. Cuboidal epithelium is actively involved in secretion, absorption and excretion.

Columnar epithelium: This is formed by a single layer of cells, rectangular in shape, on a basement membrane (Fig. 3.12C). It lines many organs and often has adaptations that make it well suited to a specific function. The lining of the stomach is formed from simple columnar epithelium without surface structures. The surface of the columnar epithelium lining the small intestine is covered with microvilli (Fig. 3.6). Microvilli provide a very large surface area for absorption of nutrients from the small intestine. In the trachea, columnar epithelium is ciliated (see Fig. 10.12, p. 241) and also contains goblet cells that secrete mucus (see Fig. 12.5, p. 282). This means that inhaled particles that stick to the mucus layer are moved towards the throat by cilia (p. 241) in the respiratory tract. In the uterine tubes, ova are propelled along by ciliary action towards the uterus.

Stratified epithelia: Stratified epithelia consist of several layers of cells of various shapes. Continual cell division in the lower (basal) layers pushes cells above nearer and nearer to the surface, where they are shed.

Basement membranes are usually absent. The main function of stratified epithelium is to protect underlying structures from mechanical wear and tear. There are two main types: stratified squamous and transitional.

Stratified squamous epithelium (Fig. 3.13): This is composed of a number of layers of cells. In the deepest layers the cells are mainly columnar and, as they grow towards the surface, they become flattened and are then shed.

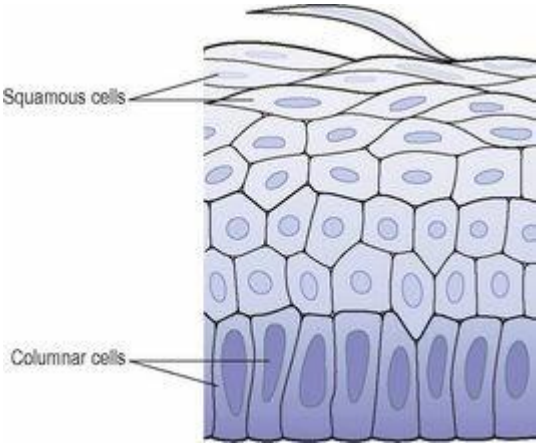


Figure 3.13 Stratified epithelium.

Keratinised stratified epithelium: This is found on dry surfaces subjected to wear and tear, i.e. skin, hair and nails. The surface layer consists of dead epithelial cells that have lost their nuclei and contain the protein keratin. This forms a tough, relatively waterproof protective layer that prevents drying of the live cells underneath. The surface layer of skin is rubbed off and is replaced from below.

Non-keratinised stratified epithelium: This protects moist surfaces subjected to wear and tear, and prevents them from drying out, e.g. the conjunctiva of the eyes, the lining of the mouth, the pharynx, the oesophagus and the vagina (Fig. 3.14).

Transitional epithelium (Fig. 3.15): This is composed of several layers of pear-shaped cells. It is found lining the urinary bladder and allows for stretching as the bladder fills.

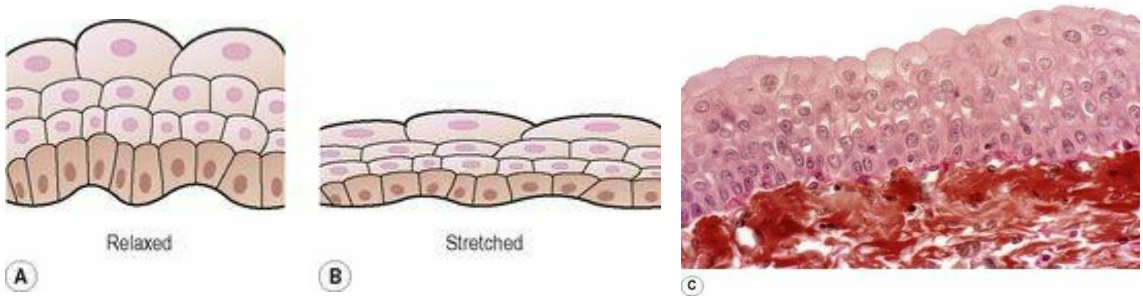


Figure 3.15 Transitional epithelium: A. Relaxed. **B.** Stretched. **C.** Light micrograph of Bladder wall showing transitional epithelium (pink) above smooth muscle and connective tissue layer (red).

10.Explain the structure, location and functions connective tissues?

Ans. **Connective tissue:** Connective tissue is the most abundant tissue in the body. The connective tissue cells are more widely separated from each other than in epithelial tissues, and intercellular substance (matrix) is present in considerably larger amounts. There are usually fibres present in the matrix, which may be of a semisolid jelly-like consistency or dense and rigid, depending upon the position and function of the tissue. The fibres form a supporting network for the cells to attach to. Most types of connective

tissue have a good blood supply. Major functions of connective tissue are: binding and structural support protection, transport, insulation.

Cells in connective tissue: Connective tissue, excluding blood, is found in all organs supporting the specialised tissue. The different types of cell involved include: fibroblasts, fat cells, macrophages, leukocytes and mast cells.

Fibroblasts: Fibroblasts are large cells with irregular processes (Fig. 3.5). They produce *collagen* and *elastic fibres* and a matrix of extracellular material. Very fine collagen fibres, sometimes called *reticulin fibres*, are found in very active tissue, such as the liver and lymphoid tissue. Fibroblasts are particularly active in tissue repair (wound healing) where they may bind together the cut surfaces of wounds or form *granulation tissue* following tissue destruction (see p. 359). The collagen fibres formed during healing shrink as they grow old, sometimes interfering with the functions of the organ involved and with adjacent structures.

Fat cells: Also known as *adipocytes*, these cells occur singly or in groups in many types of connective tissue and are especially abundant in adipose tissue (see Fig. 3.17B). They vary in size and shape according to the amount of fat they contain.

Macrophages: These are irregular-shaped cells with granules in the cytoplasm. Some are fixed, i.e. attached to connective tissue fibres, and others are motile. They are an important part of the body's defence mechanisms because they are actively phagocytic, engulfing and digesting cell debris, bacteria and other foreign bodies. Their activities are typical of those of the macrophage/monocyte defence system, e.g. monocytes in blood, phagocytes in the alveoli of the lungs, Kupffer cells in liver sinusoids, fibroblasts in lymph nodes and spleen, and microglial cells in the brain.

Leukocytes: White blood cells (p. 61) are normally found in small numbers in healthy connective tissue but neutrophils migrate in significant numbers during infection when they play an important part in tissue
defence.

Plasma cells: These develop from B-lymphocytes, a type of white blood cell (see p. 61). They synthesise and secrete specific defensive *antibodies* into the blood and tissues (see Ch. 15).

Mast cells: These cells are similar to basophil leukocytes (see p. 62). They are found in loose connective tissue and under the fibrous capsule of some organs, e.g. liver and spleen, and in considerable numbers round blood vessels. They produce granules containing *heparin*, *histamine* and other substances, which are released when the cells are damaged by disease or injury. Histamine is involved in local and general inflammatory reactions, it stimulates the secretion of gastric juice and is associated with the development of allergies and hypersensitivity states (see p. 374). Heparin prevents coagulation of blood, which may aid the passage of protective substances from blood to affected tissues.

Loose (areolar) connective tissue (Fig. 3.16): This is the most generalised type of connective tissue. The matrix is semisolid with many fibroblasts and some fat cells (adipocytes), mast cells and macrophages widely separated by elastic and collagen fibres. It is found in almost every part of the body, providing elasticity and tensile strength. It connects and supports other tissues, for example: under the skin (Fig. 3.16B) between

muscles supporting blood vessels and nerves in the alimentary canal in glands supporting secretory cells.

Adipose tissue (Fig. 3.17): Adipose tissue consists of fat cells (adipocytes), containing large fat globules, in a matrix of areolar tissue (Fig. 3.16). There are two types: white and brown.

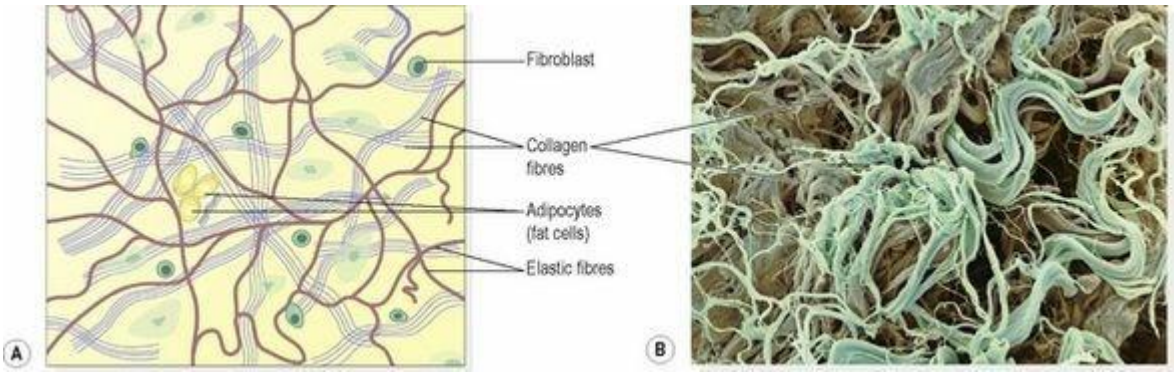


Figure 3.16 Loose (areolar) connective tissue. A. Diagram of basic structure. **B.** Coloured scanning electron micrograph of fat cells surrounded by strands of connective tissue.

Adipose tissue (Fig. 3.17): Adipose tissue consists of fat cells (adipocytes), containing large fat globules, in a matrix of areolar tissue (Fig. 3.16). There are two types: white and brown.

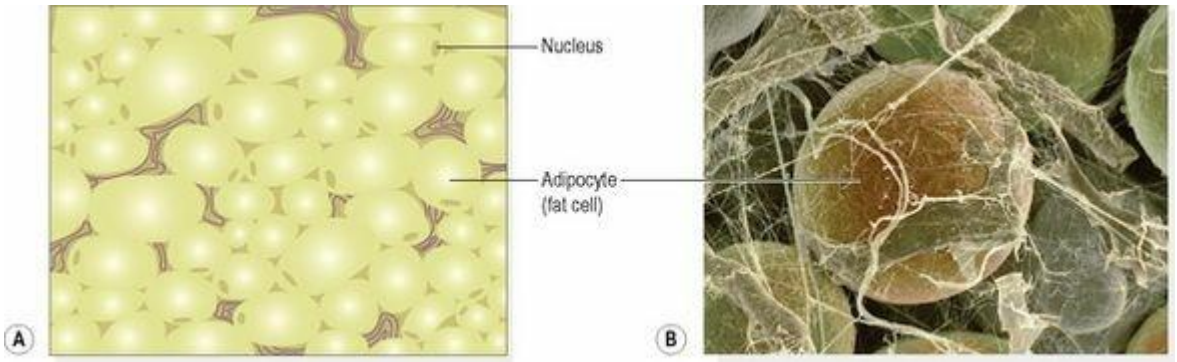


Figure 3.17 Adipose tissue. A. Diagram of basic structure. **B.** Coloured scanning electron
micrograph of fat cells surrounded by strands of connective tissue.

White adipose tissue: This makes up 20 to 25% of body weight in well-nourished adults. The amount of adipose tissue in an individual is determined by the balance between energy intake and expenditure. It is found supporting the kidneys and the eyes, between muscle fibres and under the skin, where it acts as a thermal insulator and energy store.

Brown adipose tissue: This is present in the newborn. It has a more extensive capillary network than white adipose tissue. When brown tissue is metabolised, it produces less energy and considerably more heat than other fat, contributing to the maintenance of body temperature. In some adults it is present in small amounts.

Lymphoid tissue (Fig. 3.18): This tissue, also known as reticular tissue, has a semisolid matrix with fine branching reticulin fibres. It contains reticular cells and white blood cells

(*monocytes* and *lymphocytes*). Lymphoid tissue is found in lymph nodes and all organs of the lymphatic system

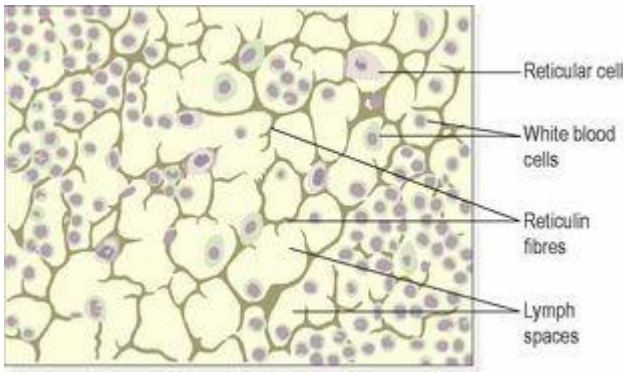


Figure 3.18 Lymphoid tissue.

Dense connective tissue: This contains more fibres and fewer cells than loose connective tissue.

Fibrous tissue (Fig. 3.19A): This tissue is made up mainly of closely packed bundles of collagen fibres with very little matrix. Fibrocytes (old and inactive fibroblasts) are few in number and are found lying in rows between the bundles of fibres. Fibrous tissue is found: forming *ligaments*, which bind bones together

as an outer protective covering for bone, called *periosteum* as an outer protective covering of some organs, e.g. the kidneys, lymph nodes and the brain forming muscle sheaths, called *muscle fascia*, which extend beyond the muscle to become the *tendon* that attaches the muscle to bone.

Elastic tissue (Fig. 3.19B): Elastic tissue is capable of considerable extension and recoil. There are few cells and the matrix consists mainly of masses of elastic fibres secreted by fibroblasts. It is found in organs where stretching or alteration of shape is required, e.g. in large blood vessel walls, the trachea and bronchi,

and the lungs.

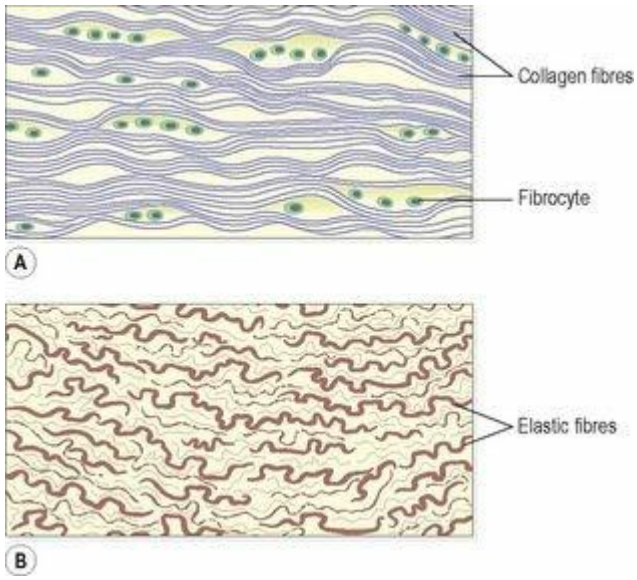


Figure 3.19: Dense connective tissue. A. Fibrous tissue. **B.** Elastic tissue.

Blood: This is a fluid connective tissue that is described in detail in Chapter 4.

Cartilage: Cartilage is firmer than other connective tissues; the cells are called *chondrocytes* and are less

numerous. They are embedded in matrix reinforced by collagen and elastic fibres. There are three types: hyaline cartilage, fibrocartilage and elastic fibrocartilage.

Hyaline cartilage (Fig. 3.20A): Hyaline cartilage is a smooth bluish-white tissue. The chondrocytes are in small groups within cell nests and the matrix is solid and smooth. Hyaline cartilage provides flexibility, support and smooth surfaces for movement at joints. It is found: on the ends of long bones that form joints forming the costal cartilages, which attach the ribs to the sternum forming part of the larynx, trachea and bronchi.

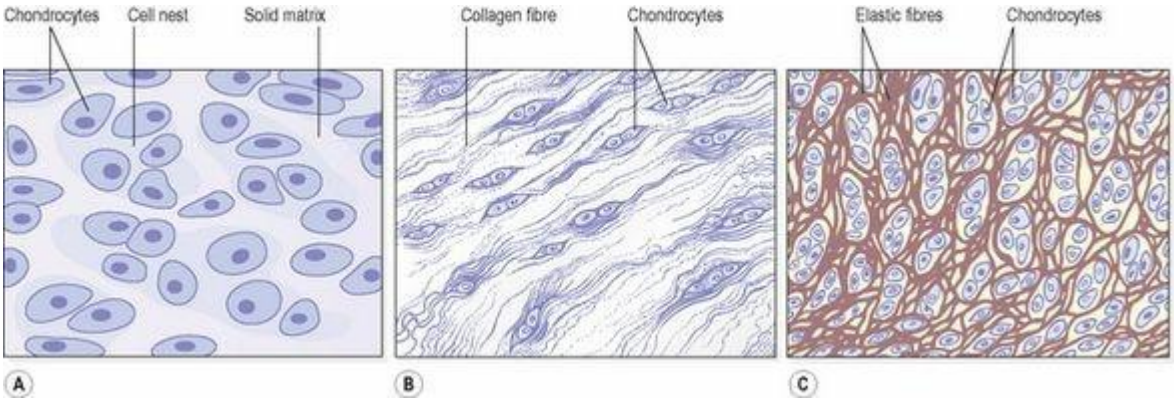


Figure 3.20 Cartilage. A. Hyaline cartilage. **B.** Fibrocartilage. **C.** Elastic fibrocartilage.

Fibrocartilage (Fig. 3.20B): This consists of dense masses of white collagen fibres in a matrix similar to that of hyaline cartilage with the cells widely dispersed. It is a tough, slightly flexible, supporting tissue found: as pads between the bodies of the vertebrae, the *intervertebral discs* between the articulating surfaces of the bones of the knee joint, called *semilunar cartilages* on the rim of the bony sockets of the hip and shoulder joints, deepening the cavities without restricting movement as *ligaments* joining bones.

Elastic fibrocartilage (Fig. 3.20C): This flexible tissue consists of yellow elastic fibres lying in a solid matrix. The chondrocytes lie between the fibres. It provides support and maintains shape of, e.g. the pinna or lobe of the ear, the epiglottis and part of the tunica media of blood vessel walls.

Bone: Bone cells (osteocytes) are surrounded by a matrix of collagen fibres strengthened by inorganic salts, especially calcium and phosphate. This provides bones with their characteristic strength and rigidity. Bone also has considerable capacity for growth in the first two decades of life, and for regeneration throughout life. Two types of bone can be identified by the naked eye: *compact bone* – solid or dense appearance *spongy* or *cancellous bone* – 'spongy' or fine honeycomb appearance. These are described in detail in Chapter 16.

11.Explain the structure, location and functions muscular tissues?

Ans: Muscle tissue: Muscle tissue is able to contract and relax, providing movement within the body and of the body itself. Muscle contraction requires an adequate blood supply to provide sufficient oxygen, calcium and nutrients and to remove waste products. There are three types of specialised contractile cells, also known as *fibres*: skeletal muscle, smooth muscle and cardiac muscle.

Skeletal muscle tissue (Fig. 3.21): This type is described as skeletal because it forms those muscles that move the bones [of the skeleton], *striated* because striations (stripes) can be seen on microscopic examination and *voluntary* as it is under conscious control. In reality, movements can be finely coordinated, e.g. writing, but may also be controlled subconsciously. For example, maintaining an upright posture does not normally require thought unless a new locomotor skill is being learned, e.g. skating or cycling, and the diaphragm maintains breathing while asleep.

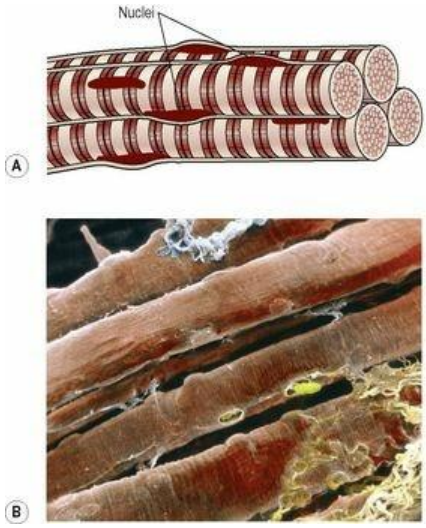


Figure 3.21 Skeletal muscle fibres. A. Diagram. **B.** Coloured scanning electron micrograph of skeletal muscle fibres and connective tissue fibres (bottom right).
Fibres are cylindrical, contain several nuclei and can be up to 35 cm long. Skeletal muscle contraction is stimulated by motor nerve impulses originating in the brain or spinal cord and ending at the neuromuscular junction (see p. 411). The properties and functions of skeletal muscle are explained in detail in Chapter 16.

Smooth muscle tissue (Fig. 3.22): Smooth muscle may also be described as *non-striated, visceral* or *involuntary*. It does not have striations and is not under conscious control. Smooth muscle has the intrinsic ability to contract and relax. Additionally, autonomic nerve impulses, some hormones and local metabolites stimulate contraction. A degree of muscle tone is always present, meaning that smooth muscle is completely relaxed for only short periods. Contraction of smooth muscle is slower and more sustained than skeletal muscle. It is found in the walls of hollow organs: regulating the diameter of blood vessels and parts of the respiratory tract propelling contents of the ureters, ducts of glands and alimentary tract expelling contents of the urinary bladder and uterus.

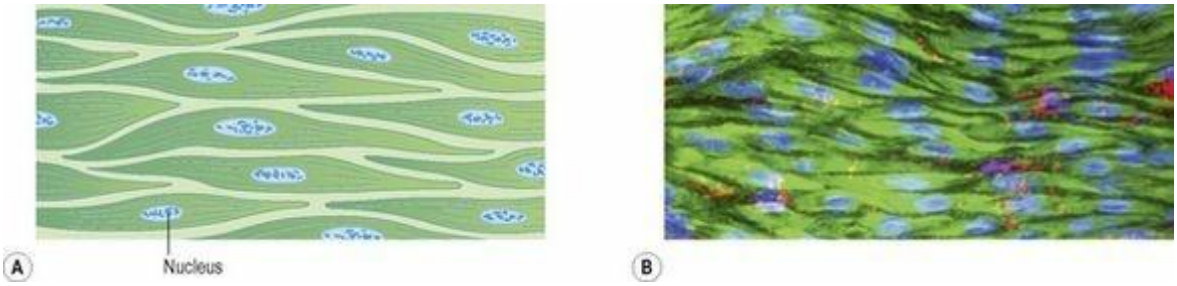


Figure 3.22. Smooth muscle. A. Diagram. **B.** Fluorescent light micrograph showing actin, a

contractile muscle protein (green), nuclei (blue) and capillaries (red).
When examined under a microscope, the cells are seen to be spindle shaped with only one central nucleus. Bundles of fibres form sheets of muscle, such as those found in the walls of the above structures.

Cardiac muscle tissue (Fig. 3.23): This type of muscle tissue is found only in the heart wall. It is not under conscious control but, when viewed under a microscope, cross-stripes (striations) characteristic of skeletal muscle can be seen. Each fibre (cell) has a nucleus and one or more branches. The ends of the cells and their branches are in very close contact with the ends and branches of adjacent cells. Microscopically these 'joints', or *intercalated discs*, can be seen as lines that are thicker and darker than the ordinary cross-stripes. This arrangement gives cardiac muscle the appearance of a sheet of muscle rather than a very large
number of individual fibres. The end-to-end continuity of cardiac muscle cells has significance in relation to the way the heart contracts. A wave of contraction spreads from cell to cell across the intercalated discs, which means that cells do not need to be stimulated individually.

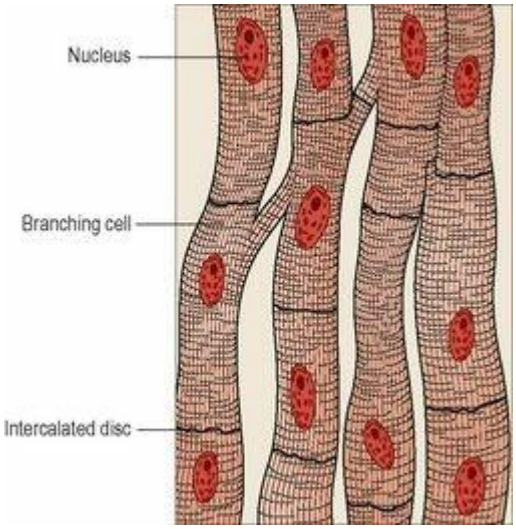


Figure 3.23 Cardiac muscle fibres.

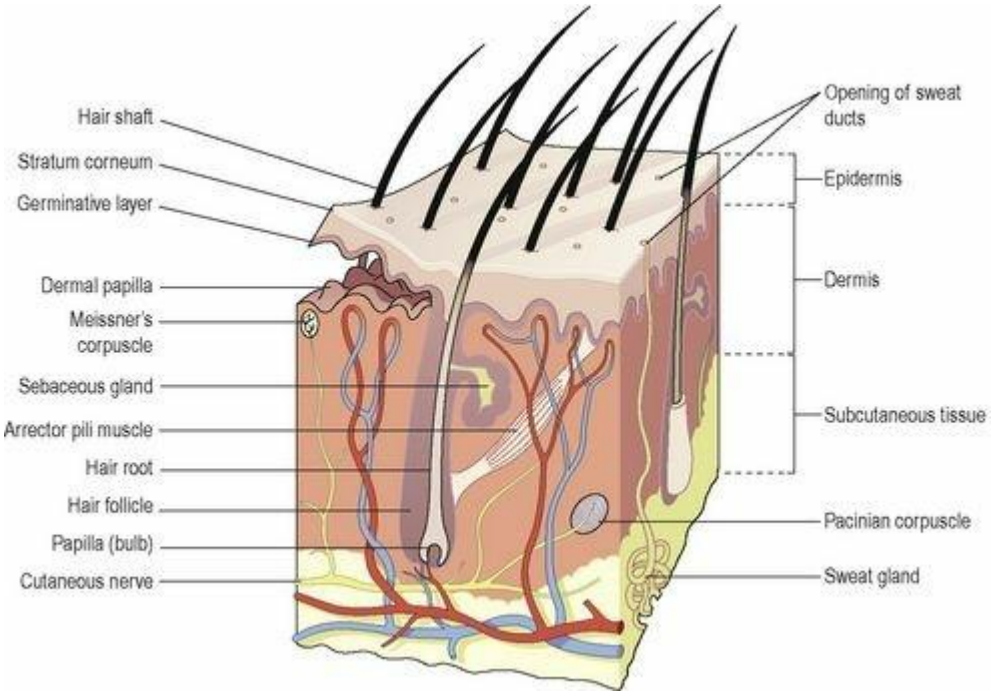
The heart has an intrinsic pacemaker system, which means that it beats in a coordinated manner without external nerve stimulation, although the rate at which it beats is influenced by autonomic nerve impulses, some hormones, local metabolites and other substances.

12. Describe in detail Structure & functions of skin?

Ans: The skin is the largest organ in the body and has a surface area of about 1.5 to 2 m2 in adults and it includes glands, hair and nails. There are two main layers: the epidermis and the dermis. Between the skin and underlying structures is the subcutaneous layer composed of areolar tissue and adipose (fat) tissue.

Epidermis: The epidermis is the most superficial layer of the skin and is composed of *stratified keratinised*
squamous epithelium (see Fig. 3.13, p. 35), which varies in thickness in different parts of the body. It is thickest on the palms of the hands and soles of the feet. There are no blood

vessels or nerve endings in the epidermis, but its deeper layers are bathed in interstitial fluid from the dermis, which provides oxygen and nutrients, and drains away as lymph. There are several layers (strata) of cells in the epidermis which extend from the deepest *germinative layer* to the most superficial *stratum corneum* (a thick horny layer) (Fig. 14.1). The cells on the surface are flat, thin, non-nucleated, dead cells, or *squames*, in



which the cytoplasm has been replaced by the fibrous protein *keratin*. These cells are constantly being rubbed off and replaced by cells that originated in the germinative layer and have undergone gradual change as they progressed towards the surface. Complete replacement of the epidermis takes about a month. The maintenance of healthy epidermis depends upon three processes being synchronised: desquamation (shedding) of the keratinised cells from the surface effective keratinisation of the cells approaching the surface continual cell division in the deeper layers with newly formed cells being pushed to the surface. Hairs, secretions from sebaceous glands and ducts of sweat glands pass through the epidermis to reach the surface (see Fig. 14.4). The surface of the epidermis is ridged by projections of cells in the dermis called *papillae* (Fig. 14.2). The pattern of ridges on the fingertips is unique to every individual and the impression made by them is the 'fingerprint'. The downward projections of the germinative layer between the papillae are believed to aid nutrition of epidermal cells and stabilise the two layers, preventing damage due to shearing forces. *Blisters* develop when trauma causes separation of the dermis and epidermis and serous fluid collects between the two layers.

Figure 14.2 The skin showing the main structures in the dermis.

Skin colour is affected by various factors. Melanin, a dark pigment derived from the amino acid tyrosine and secreted by *melanocytes* in the deep germinative layer, is absorbed by surrounding epithelial cells. The amount is genetically determined and varies between different parts of the body, between people of the same ethnic origin and between ethnic groups. The number of melanocytes is fairly constant so the differences in

colour depend on the amount of melanin secreted. It protects the skin from the harmful effects of sunlight. Exposure to sunlight promotes synthesis of melanin. Normal saturation of haemoglobin and the amount of blood circulating in the dermis give white skin its pink colour. Excessive levels of bile pigments in blood and carotenes in subcutaneous fat give the skin a yellowish colour.

Dermis (Fig. 14.2): The dermis is tough and elastic. It is formed from connective tissue and the matrix contains *collagen fibres* (see Fig. 3.16, p. 36) interlaced with *elastic fibres*. Rupture of elastic fibres occurs when then skin is overstretched, resulting in permanent striae, or stretch marks, that may be found in pregnancy and obesity. Collagen fibres bind water and give the skin its tensile strength, but as this ability

declines with age, wrinkles develop. Fibroblasts (see Fig. 3.5, p. 30), macrophages and mast cells are the main cells found in the dermis. Underlying its deepest layer there is areolar tissue and varying amounts of adipose (fat) tissue. The structures in the dermis are: blood vessels, lymph vessels, sensory (somatic) nerve endings sweat glands and their ducts hairs, arrector pili muscles and sebaceous glands.

Blood and lymph vessels: Arterioles form a fine network with capillary branches supplying sweat glands, sebaceous glands, hair follicles and the dermis. Lymph vessels form a network throughout the dermis.

Sensory nerve endings Sensory receptors (specialised nerve endings) sensitive to *touch, temperature, pressure* and *pain* are widely distributed in the dermis. Incoming stimuli activate different types of sensory receptors (Fig. 14.2, Box 14.1). The Pacinian corpuscle is sensitive to deep pressure and is shown in Figure 14.3. The skin is an important sensory organ through which individuals receive information about their environment. Nerve impulses, generated in the sensory receptors in the dermis, are conveyed to the spinal cord by sensory nerves, then to the sensory area of the cerebrum where the sensations are perceived (see Fig. 7.23B, p. 151).

Sweat glands: These are widely distributed throughout the skin and are most numerous in the palms of the hands, soles of the feet, axillae and groins. They are formed from epithelial cells. The bodies of the glands lie coiled in the subcutaneous tissue. There are two types of sweat gland. The commonest type opens onto the skin surface through tiny pores, and the sweat produced here is a clear, watery fluid important in regulating body temperature. The second type opens into hair follicles, and is found, for example, in the axilla. Bacterial decomposition of these secretions causes an unpleasant odour. A specialised example of this type of gland is the ceruminous gland of the outer ear, which secretes earwax (Ch. 8). The most important function of sweat, which is secreted by glands, is in the regulation of body temperature. Excessive sweating may lead to dehydration and serious depletion of sodium chloride unless intake of water and salt is appropriately increased. After 7 to 10 days' exposure to high environmental temperatures the amount of salt lost is substantially reduced but water loss remains high.

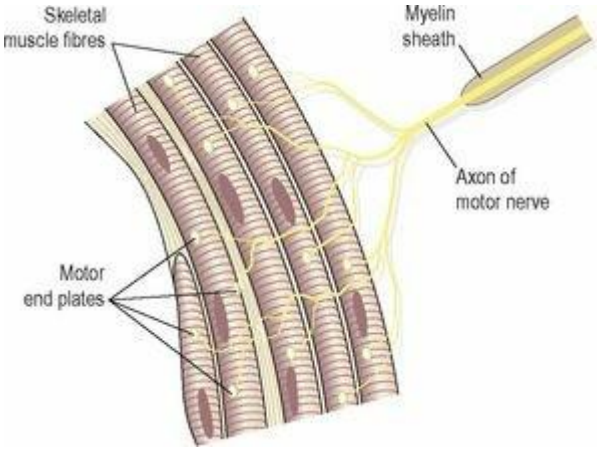
Hairs: These are formed by a down growth of epidermal cells into the dermis or subcutaneous tissue, called *hair follicles*. At the base of the follicle is a cluster of cells called the *papilla* or *bulb*. The hair is formed by multiplication of cells of the bulb and as they are pushed upwards, away from their source of nutrition, the cells die and become keratinised. The part of the hair above the skin is the *shaft* and the remainder, the *root*

(Fig. 14.2). Figure 14.4 shows hair growing through the skin. Desquamation at the surface provides a haven for micro-organisms.

Arrector pili (Fig. 14.2): These are little bundles of smooth muscle fibres attached to the hair follicles. Contraction makes the hair stand erect and raises the skin around the hair, causing 'goose flesh'. The muscles are stimulated by sympathetic nerve fibres in response to fear and cold. Erect hairs trap air, which acts as an insulating layer. This is an efficient warming mechanism, especially when accompanied by shivering, i.e. involuntary contraction of skeletal muscles.

Sebaceous glands (Fig. 14.2): These consist of secretory epithelial cells derived from the same tissue as the hair follicles. They secrete an oily substance, *sebum*, into the hair follicles and are present in the skin of all parts of the body except the palms of the hands and the soles of the feet. They are most numerous in the skin of the scalp, face, axillae and groins. In regions of transition from one type of superficial epithelium to another, such as lips, eyelids, nipple, labia minora and glans penis, there are sebaceous glands that are independent of hair follicles, secreting sebum directly onto the surface. Sebum keeps the hair soft and pliable and gives it a shiny appearance. On the skin it provides some waterproofing and acts as a bactericidal and fungicidal agent, preventing infection. It also prevents drying and cracking of skin, especially on exposure to heat and sunshine. The activity of these glands increases at puberty and is less at the extremes of age, rendering the skin of infants and older adults prone to the effects of excessive moisture (*maceration*).

13. Describe the physiology of muscle contraction & neuromuscular junction? Ans:
Contraction: The skeletal muscle cell contracts in response to stimulation from a nerve fibre, which supplies the muscle cell usually about halfway along its length. The name given to a synapse between a motor nerve and a skeletal muscle fibre is the *neuromuscular junction*. When the action potential spreads from the nerve along the sarcolemma, it is conducted deep into the muscle cell through a special network of channels that run through the sarcoplasm, and releases calcium from the intracellular stores. Calcium triggers the binding of myosin to the actin filament next to it, forming so-called cross bridges. ATP then provides the energy for the two filaments to slide over each other, pulling the Z lines at each end of the sarcomere closer to one another, shortening the sarcomere (Fig. 16.54C). If enough fibres are stimulated to do this at the



same time, the whole muscle will shorten (contract). This is called the *sliding filament theory*. The muscle relaxes when nerve stimulation stops. Calcium is pumped back into its intracellular storage areas, which breaks the cross-bridges between the actin and myosin filaments. They then slide back into their starting positions, lengthening the sarcomeres and returning the muscle to its original length. The axons of motor neurones, carrying impulses to skeletal muscle to produce contraction, divide into a number of fine filaments terminating in minute pads called synaptic knobs. The space between the synaptic knob and the muscle cell is called the synaptic cleft. Stimulation of the motor neurone releases the neurotransmitter acetylcholine (ACh), which diffuses across the synaptic cleft and binds to acetylcholine receptors on the postsynaptic membrane on the *motor end plate* (the area of the muscle membrane directly across the synaptic cleft, Fig. 16.56). Acetylcholine causes contraction of the muscle cell.

Figure 16.56 The neuromuscular junction.
Motor units: Each muscle fibre is stimulated by only one synaptic knob, but since each motor nerve has many synaptic knobs, it stimulates a number of muscle fibres. Figure 16.57 shows an electron micrograph of a motor nerve and two of its motor end plates.
One nerve fibre and the muscle fibres it supplies constitute a *motor unit*. Nerve impulses cause serial contraction of motor units in a muscle, and each unit contracts to its full capacity. The *strength* of the contraction depends on the *number* of motor units in action at a particular time. Some motor units contain large numbers of muscle fibres, i.e. one nerve serves many muscle cells. This arrangement is associated with large-scale,

powerful movements, such as in the legs or upper arms. Fine, delicate control of muscle movement is achieved when one motor unit contains very few muscle fibres, as in the muscles controlling eye movement.

Action of skeletal muscle: When individual muscle cells in a muscle shorten, they pull on the connective tissue framework running through the whole muscle, and the muscle develops a degree of tension (tone).

Muscle tone: When a muscle fibre contracts, it obeys the *all-or-none law*, i.e. the whole fibre either contracts completely or not at all. The degree of contraction achieved by a whole muscle depends therefore on the number of fibres within it that are contracting at any one time, as well as how often they are stimulated. Powerful contractions involve a larger proportion of available fibres than weaker ones; to lift a heavy weight, more muscle fibres are required to contract than to lift a lighter one. *Muscle tone* is a sustained, partial muscle contraction that allows posture to be maintained without fatiguing the muscles involved. For instance, keeping the head upright requires constant activity of the muscles of the neck and shoulders. Groups of muscle fibres within these muscles take it in turns to contract, so that at any one time, some fibres are contracted and others are resting. This allows the effort required to hold the head upright to be distributed throughout the muscles involved. Good muscle tone protects joints and gives a muscle firmness and shape, even when relaxed.

Muscle fatigue: To work at sustained levels, muscles need an adequate supply of oxygen and fuel molecules such as glucose. Fatigue occurs when a muscle works at a level that exceeds these supplies. The muscle response decreases with fatigue. The chemical energy (ATP) that muscles require is usually derived from the breakdown of carbohydrate and fat; protein may be used if supplies of fat and carbohydrate are exhausted. An adequate oxygen supply is needed to release fully all the energy stored within these fuel molecules; without it, the body uses anaerobic metabolic pathways (p. 308) that are less efficient and lead to lactic acid production. Fatigue resulting from inadequate oxygen supply, as in strenuous exercise, occurs when lactic acid accumulates in working muscles. Fatigue may also occur because energy stores are exhausted, or due to physical injury to muscle, which may occur after prolonged episodes of strenuous activity, e.g. marathon running.

Muscle recovery: After exercise, muscle needs a period of time to recover, to replenish its ATP and glycogen stores and to repair any damaged fibres. For some time following exercise, depending on the degree of exertion, the *oxygen debt* remains (an extended period of increased oxygen demand), as the body converts excess lactic acid to pyruvic acid and replaces its energy stores.

Factors affecting skeletal muscle performance: Skeletal muscle performs better when it is regularly exercised. Training improves endurance and power. Anaerobic training, such as weightlifting, increases muscle bulk because it increases the size of individual fibres within the muscle (hypertrophy). Ageing reduces the size of muscle fibres as well as their endurance and strength.

The action of skeletal muscles: In order to move a body part, the muscle or its tendon must stretch across at least one joint. When it contracts, the muscle then pulls one bone towards another. For example, when the elbow is bent during flexion of the forearm, the main mover is the biceps brachii, which is anchored on the scapula at one end and on the

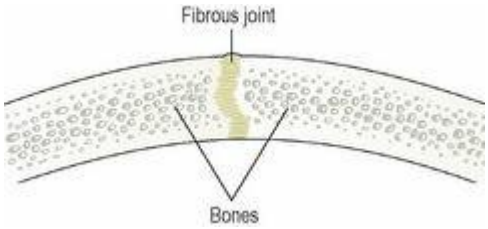
radius at the other. When it contracts, its shortening pulls on the radius, moving the forearm up toward the upper arm and bending the elbow. This example also illustrates another feature of muscle arrangement: that of *antagonistic pairs*. Many muscles/muscle groups of the body are arranged so that their actions oppose one another. Using the example of bending the elbow, when the main flexors on the front of the upper arm contract, the muscles at the back of the upper arm must simultaneously relax to prevent injury. Isometric and isotonic contraction Contraction of a muscle usually results in its shortening, as happens for instance to the biceps muscle if the forearm is used to pick up a cup. The power generated by the muscle is used to lift the manageable weight, and tension in the muscle remains constant. In this situation, the contraction is said to be isotonic (iso = same; tonic = tension). However, imagine trying to lift an 80 kg man with one hand. Most people would be unable to perform this task, but the muscles of the arm and shoulder would still be working hard as they attempted it. In this situation, because the resistance from the man's weight is too great for him to be moved by the efforts of the lifter, the muscles would be unable to shorten, and the power generated increases the muscle tension instead. This is *isometric* contraction (iso = same; metric = length).

14. Write down classification of joints?

Ans: A joint is the site at which any two or more bones articulate or come together. Joints allow flexibility and movement of the skeleton and allow attachment between bones.

Fibrous joints: The bones forming these joints are linked with tough, fibrous material. Such an arrangement often permits no movement. For example, the joints between the skull bones, the *sutures*, are completely immovable (Fig. 16.43), and the healthy tooth is cemented into the mandible by the periodontal ligament. The tibia and fibula in the leg are held together along their shafts by a sheet of fibrous tissue called the interosseous membrane (Fig. 16.40). This is a fibrous joint that allows a limited amount of movement and stabilises the alignment of the bones.

Figure 16.43 Suture (fibrous joint) of the skull.



Cartilaginous joints: These joints are formed by a pad of fibrocartilage, a tough material that acts as a shock absorber. The joint may be immovable, as in the cartilaginous epiphyseal plates, which in the growing child link the diaphysis of a long bone to the epiphysis (p. 382). In other joints, a limited degree of movement may take place, as between the vertebrae, which are separated by the intervertebral discs (Fig. 16.44), or at the symphysis pubis (Fig. 16.37), which is softened by circulating hormones during pregnancy to allow for childbirth.

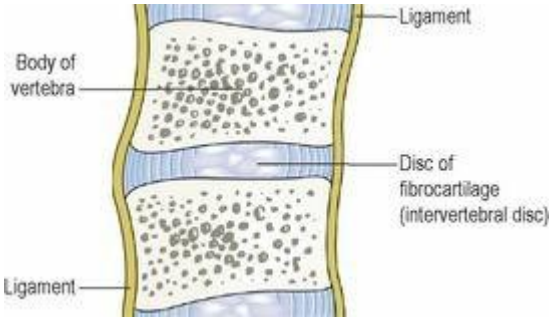
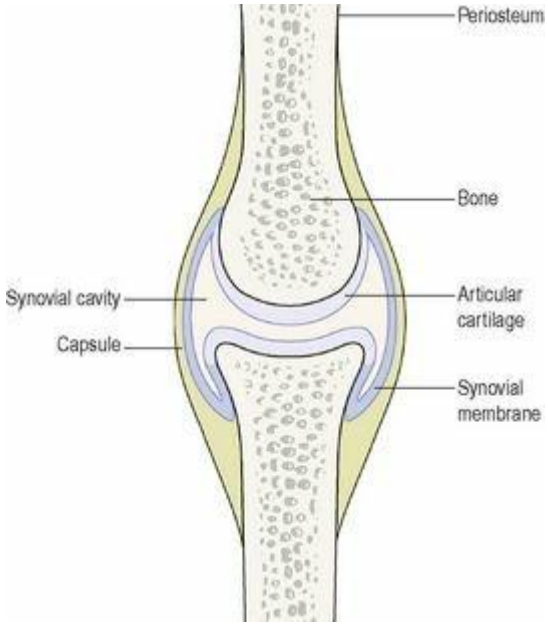


Figure 16.44 The cartilaginous joint between adjacent vertebral bodies.

Synovial joints: Synovial joints are characterised by the presence of a space or capsule between the articulating bones (Fig. 16.45). The ends of the bones are held close together by a sleeve of fibrous tissue, and the capsule is lubricated with a small amount of fluid.



Most synovial joints permit a range of movement.

Figure 16.45 The basic structure of a synovial joint.

Characteristics of a synovial joint

All synovial joints have certain characteristics in common (Fig. 16.45).

Articular or hyaline cartilage: The parts of the bones which are in contact are always covered with hyaline cartilage (see Fig. 3.20A, p. 38). This provides a smooth articular surface, reduces friction and is strong enough to absorb compression forces and bear the weight of the body. The cartilage lining, which is up to 7 mm thick in young people, becomes thinner and less compressible with age. This leads to increasing stress on other structures in the joint. Cartilage has no blood supply and receives its nourishment from synovial fluid.

Capsule or capsular ligament: The joint is surrounded and enclosed by a sleeve of fibrous tissue which holds the bones together. It is sufficiently loose to allow freedom of movement but strong enough to protect it from injury.

Synovial membrane: This epithelial layer lines the capsule and covers all non-weight-bearing surfaces inside the joint. It secretes synovial fluid.

Synovial fluid: This is a thick sticky fluid, of egg-white consistency, which fills the synovial cavity. It:
nourishes the structures within the joint cavity contains phagocytes, which remove microbes and cellular debris acts as a lubricant maintains joint stability prevents the ends of the bones from being separated, as does a little water between two glass surfaces. Little sacs of synovial fluid or *bursae* are present in some joints, e.g. the knee. They act as cushions to prevent friction between a bone and a ligament or tendon, or skin where a bone in a joint is near the surface.
Other intracapsular structures: Some joints have structures within the capsule, which assist in maintenance of stability, e.g. fat pads and menisci in the knee joint. When these structures do not bear weight they are covered by synovial membrane.
Extracapsular structures: *Ligaments* that blend with the capsule provide additional stability at most joints.
Muscles or their *tendons* also provide stability and stretch across the joints they move. When the muscle contracts it shortens, pulling one bone towards the other.
Nerve and blood supply: Nerves and blood vessels crossing a joint usually supply the capsule and the muscles that move it.

Types of synovial joint

Synovial joints are classified according to the range of movement possible (Table 16.2) or to the shape of the articulating parts of the bones involved.
Ball and socket joints: The head of one bone is ball-shaped and articulates with a cup-shaped socket of another. The joint allows for a wide range of movement, including flexion, extension, adduction, abduction, rotation and circumduction. Examples include the shoulder and hip.
Hinge joints: The articulating ends of the bones form an arrangement like a hinge on a door, and movement is therefore restricted to flexion and extension. The elbow joint is one example, permitting only flexion and extension of the forearm. Other hinge joints include the knee, ankle and the joints between the phalanges of the fingers and toes (interphalangeal joints).
Gliding joints: The articular surfaces are flat or very slightly curved and glide over one another, but the amount of movement possible is very restricted; this group of joints is the least movable of all the synovial
joints. Examples include the joints between the carpal bones in the wrist, the tarsal bones in the foot, and between the processes of the spinal vertebrae (note that the joints between the vertebral bodies are the cartilaginous discs, Fig. 16.44).
Pivot joints: These joints allow a bone or a limb to rotate. One bone fits into a hoop-shaped ligament that holds it close to another bone and allows it to rotate in the ring thus formed. For example, the head rotates on
the pivot joint formed by the dens of the axis held within the ring formed by the transverse ligament and the odontoid process of the atlas (Fig. 16.22).
Condyloid joints: A condyle is a smooth, rounded projection on a bone and in a condyloid joint it sits within a cupshaped depression on the other bone. Examples include the joint between the condylar process of the mandible and the temporal bone, and the joints between the metacarpal and phalangeal bones of the

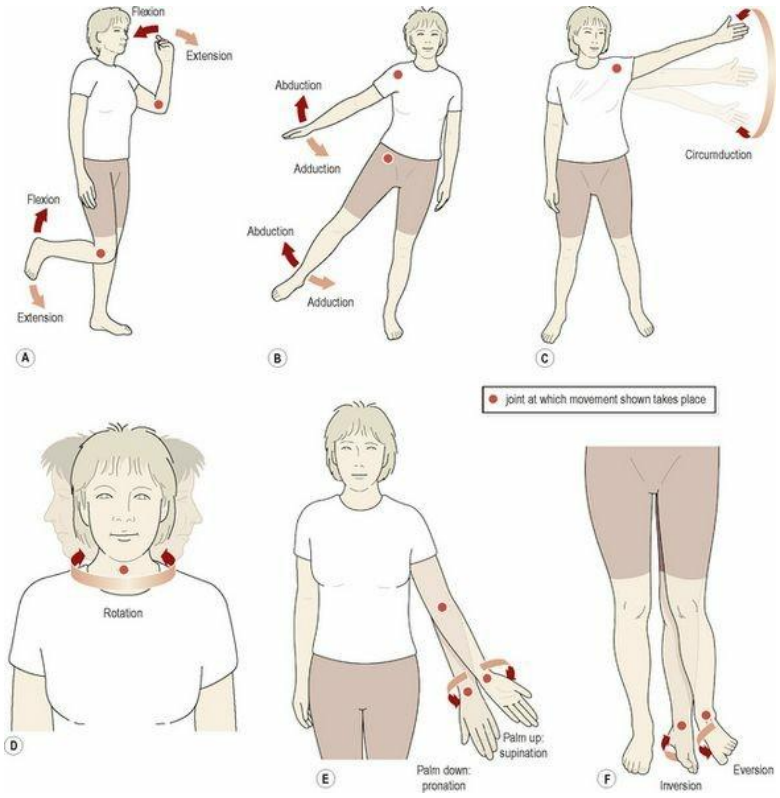
hand, and between the metatarsal and phalangeal bones of the foot. These joints permit flexion, extension, abduction, adduction and circumduction.

Saddle joints: The articulating bones fit together like a man sitting on a saddle. The most important saddle joint is at the base of the thumb, between the trapezium of the wrist and the first metacarpal bone (Fig. 16.35). The range of movement is similar to that at a condyloid joint but with additional flexibility; *opposition* of the thumb, the ability to touch each of the fingertips on the same hand, is due to the nature of the thumb joint.

15. Explain different parts of joint movement?

Ans.

Movement	**Definition**
Flexion	Bending, usually forward but occasionally backward, e.g. knee joint
Extension	Straightening or bending backward
Abduction	Movement away from the midline of the body
Adduction	Movement towards the midline of the body
Circumduction	Movement of a limb or digit so that it describes the shape of a cone
Rotation	Movement round the long axis of a bone
Pronation	Turning the palm of the hand down
Supination	Turning the palm of the hand up
Inversion	Turning the sole of the foot inwards
Eversion	Turning the sole of the foot outwards



16.Explain Organization of neuron & Neuroglia?

Ans. The nervous system consists of *neurones*, which conduct nerve impulses and are supported by unique connective tissue cells known as *neuroglia*.

There are vast numbers of cells, 1 trillion (1012) glial cells and ten times fewer (1011) neurones. Each neurone (Fig. 7.2) consists of a *cell body* and its processes, one *axon* and many *dendrites*. Neurones are commonly referred to as nerve cells. Bundles of axons

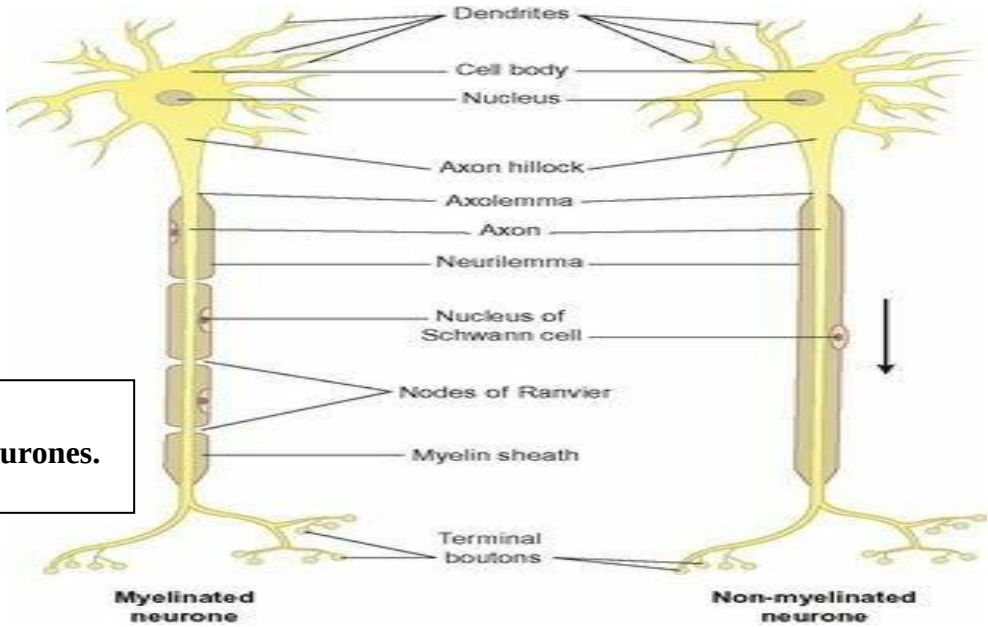


Figure 7.2 The structure of neurones.

bound together are called *nerves*. Neurones cannot divide, and for survival they need a continuous supply of oxygen and glucose. Unlike many other cells, neurones can synthesise chemical energy (ATP) only from glucose.

Arrow indicates direction of impulse conduction. Neurones generate and transmit electrical impulses called *action potentials.* The initial strength of the impulse is maintained throughout the length of the neurone. Some neurones initiate nerve impulses while others act as 'relay stations' where impulses are passed on and sometimes redirected. Nerve impulses can be initiated in response to stimuli from: outside the body, e.g. touch, light waves inside the body, e.g. a change in the concentration of carbon dioxide in the blood alters respiration; a thought may result in voluntary movement. Transmission of nerve signals is both electrical and chemical. The action potential travelling down the nerve axon is an electrical signal, but because nerves do not come into direct contact with each other, the signal between a nerve cell and the next cell in the chain is chemical.

Cell bodies: Nerve cells vary considerably in size and shape but they are all too small to be seen by the naked eye. Cell bodies form the *grey matter* of the nervous system and are found at the periphery of the brain and in the centre of the spinal cord. Groups of cell bodies are called *nuclei* in the central nervous system and *ganglia* in the peripheral nervous system. An important exception is the basal ganglia (nuclei)
situated within the cerebrum.

Axons and dendrites: Axons and dendrites are extensions of cell bodies and form the *white matter* of the nervous system. Axons are found deep in the brain and in groups, called *tracts*, at the periphery of the spinal cord. They are referred to as *nerves* or *nerve fibres* outside the brain and spinal cord.

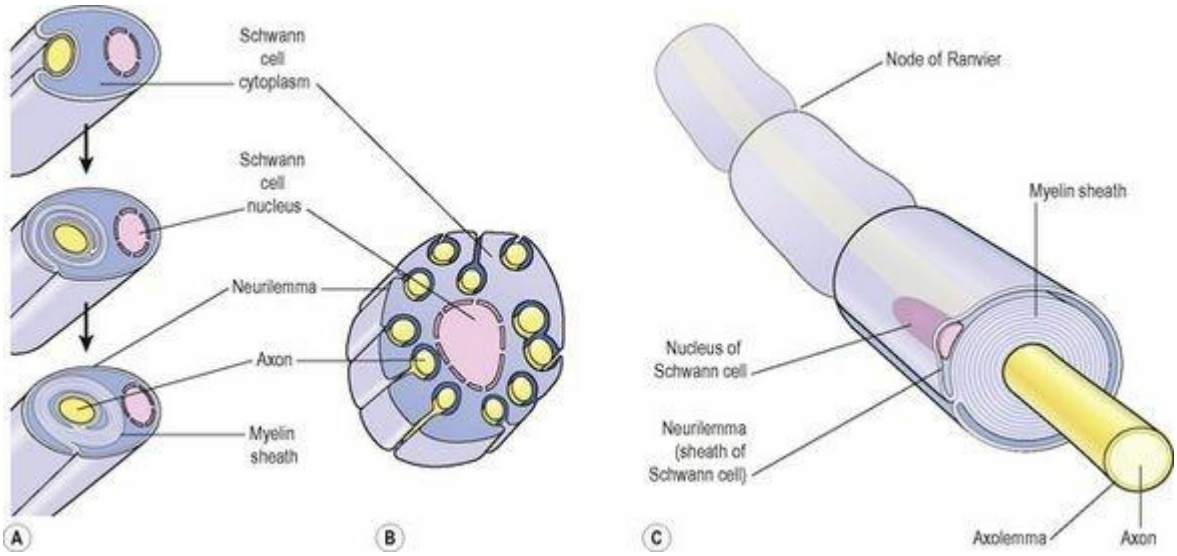
Axons: Each nerve cell has only one axon, which begins at a tapered area of the cell body, the *axon hillock.*

They carry impulses away from the cell body and are usually longer than the dendrites, sometimes as long as 100 cm.

Structure of an axon: The membrane of the axon is called the *axolemma* and it encloses the cytoplasmic extension of the cell body.

Myelinated neurones: Large axons and those of peripheral nerves are surrounded by a *myelin sheath* (Fig. 7.3A). This consists of a series of *Schwann cells* arranged along the length of the axon. Each one is wrapped
around the axon so that it is covered by a number of concentric layers of Schwann cell plasma membrane. Between the layers of plasma membrane there is a small amount of fatty substance called *myelin*. The outermost layer of the Schwann cell plasma membrane is the *neurilemma*. There are tiny areas of exposed axolemma between adjacent Schwann cells, called *nodes of Ranvier*, which assist the rapid transmission of nerve impulses in myelinated neurones (Fig. 7.2). Figure 7.4 shows a section through a nerve fibre at a node of Ranvier where the area without myelin can be clearly seen.

Figure 7.3 Arrangement of myelin. **A.** Myelinated neurone. **B.** Non-myelinated



neurone. **C.** Length of myelinated axon.

Non-myelinated neurones: Postganglionic fibres and some small fibres in the central nervous system are *non-myelinated*. In this type a number of axons are embedded in Schwann cell plasma membranes (Fig. 7.3B). The adjacent Schwann cells are in close association and there is no exposed axolemma. The speed of transmission of nerve impulses is significantly slower in non-myelinated fibres.

Dendrites: These are the many short processes that receive and carry incoming impulses towards cell bodies. They have the same structure as axons but are usually shorter and branching. In motor neurones dendrites form part of synapses (see Fig. 7.7) and in sensory neurones they form the sensory receptors that respond to specific stimuli.

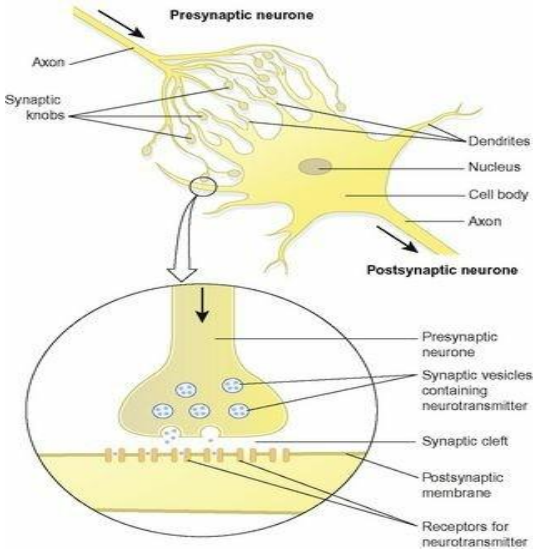


Figure 7.7 Diagram of a synapse.

The nerve impulse (action potential)

An impulse is initiated by stimulation of sensory nerve endings or by the passage of an impulse from another nerve. Transmission of the impulse, or action potential, is due to

movement of ions across the nerve cell membrane. In the resting state the nerve cell membrane is polarised due to differences in the concentrations of ions across the plasma membrane. This means that there is a different electrical charge on each side of the membrane, which is called the *resting membrane potential*. At rest the charge on the outside is positive and inside it is negative. The principal ions involved are: sodium (Na+), the main extracellular cation potassium (K+), the main intracellular cation. In the resting state there is a continual tendency for these ions to diffuse along their concentration gradients, i.e. K+ outwards and Na+ into cells. When stimulated, the permeability of the nerve cell membrane to these ions changes. Initially Na+ floods into the neurone from the extracellular fluid causing *depolarisation*, creating a *nerve impulse* or *action potential*. Depolarisation is very rapid, enabling the conduction of a nerve impulse along the entire length of a neurone in a few milliseconds (ms). It passes from the point of stimulation in one direction only, i.e. away from the point of stimulation towards the area of resting potential. The one-way direction of transmission is ensured
because following depolarisation it takes time for *repolarisation* to occur. Almost immediately following the entry of sodium, K+ floods out of the neurone and the movement of these ions returns the membrane potential to its resting state. This is called the *refractory period* during which restimulation is not possible. As the neurone returns to its original resting state, the action of the *sodium–potassium pump* expels Na+ from the cell in exchange for K+. In myelinated neurones, the insulating properties of the myelin sheath prevent the movement of ions. Therefore electrical changes across the membrane can only occur at the gaps in the myelin sheath, i.e. at the nodes of Ranvier (see Fig. 7.2). When an impulse occurs at one node, depolarisation passes along the myelin sheath to the next node so that the flow of current appears to 'leap' from one node to the next. This is called *saltatory conduction* (Fig. 7.5).

17.Write down the Classification of peripheral nervous system?

Ans: PNS classified in to two types

a) Autonomic NS: ANS divided in to sympathetic and parasympatheticn NS

b) Somatic NS

18.Explain Structure and functions of sympathetic and parasympathetic nervous system?

Ans: The autonomic nervous system is separated into two divisions:

sympathetic (thoracolumbar outflow)

parasympathetic (craniosacral outflow).

The two divisions have both structural and functional differences. They normally work in an opposing manner, thereby maintaining balance of involuntary functions. Sympathetic activity tends to predominate in stressful situations and parasympathetic activity during rest. Each division has two efferent neurones between the central nervous system and effector organs. These are: the preganglionic neurone, the postganglionic neurone. The cell body of the preganglionic neurone is in the brain or spinal cord. Its axon terminals synapse with the cell body of the postganglionic neurone in an *autonomic ganglion* outside the CNS. The postganglionic neurone conducts impulses to the effector organ.

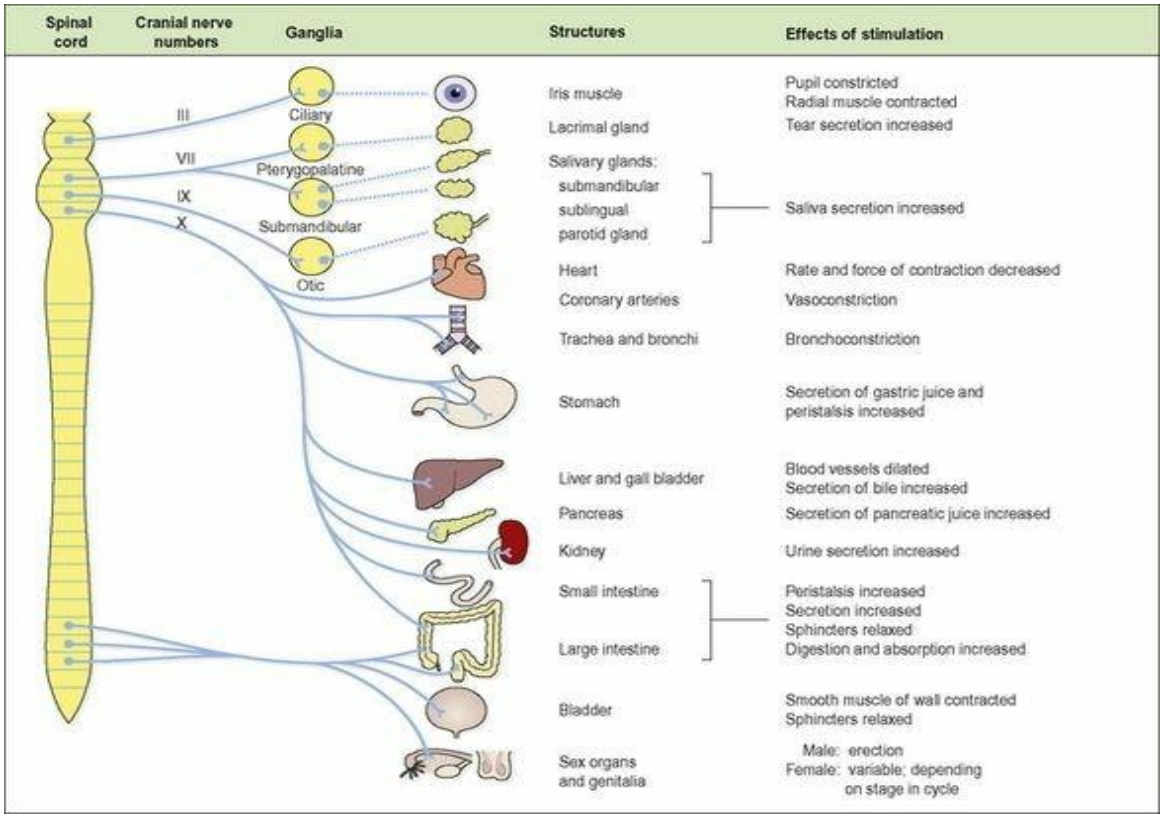


Figure 7.47 The parasympathetic outflow, the main structures supplied and the effects of stimulation. Solid blue lines – preganglionic fibres; broken lines – postganglionic fibres. Where there are no broken lines, the postganglionic neurone is in the wall of the structure

The motor fibres arise from nuclei in the medulla and supply the smooth muscle and secretory glands of the pharynx, larynx, trachea, bronchi, heart, carotid body, oesophagus, stomach, intestines, exocrine pancreas, gall bladder, bile ducts, spleen, kidneys, ureter and blood vessels in the thoracic and abdominal cavities. Two neurones (preganglionic and postganglionic) are involved in the transmission of impulses from their source to the effector organ (Fig. 7.47). The neurotransmitter at both synapses is acetylcholine.

The preganglionic neurone: This is usually long in comparison to its counterpart in the sympathetic nervous system and has its cell body either in the brain or in the spinal cord. Those originating in the brain are the cranial nerves III, VII, IX and X, arising from nuclei in the midbrain and brain stem, and their nerve fibres terminate at or near effector organs. The cell bodies of the *sacral outflow* are in the lateral columns of grey matter at the distal end of the spinal cord. Their fibres leave the cord in sacral segments 2, 3 and 4 and synapse with postganglionic neurones in the walls of pelvic organs.

The postganglionic neurone: This is usually very short and has its cell body either in a ganglion or, more often, in the wall of the organ supplied.

Sympathetic nervous system: Since the preganglionic neurones originate in the spinal cord at the thoracic and lumbar levels, the alternative name of 'thoracolumbar outflow' is apt (Fig. 7.46).

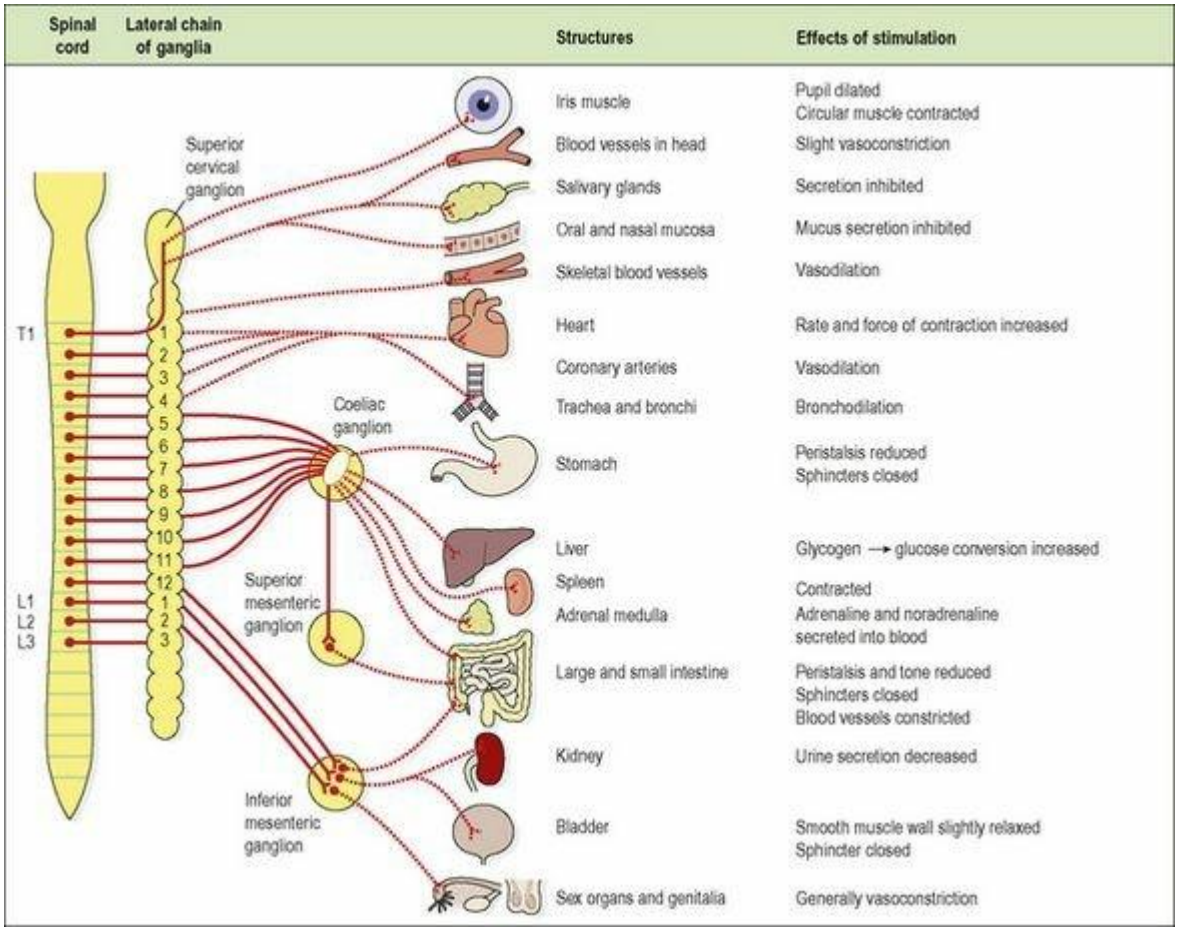


Figure 7.46 The sympathetic outflow, the main structures supplied and the effects of stimulation. Solid red lines – preganglionic fibres; broken lines – postganglionic fibres. There is a
right and left lateral chain of ganglia.

The preganglionic neurone: This has its cell body in the *lateral column of grey matter* in the spinal cord between the levels of the 1st thoracic and 2nd or 3rd lumbar vertebrae. The nerve fibre of this cell leaves the cord by the anterior root and terminates at a synapse in one of the ganglia either in the *lateral chain of sympathetic ganglia* or passes through it to one of the *prevertebral ganglia* (see below). Acetylcholine is the neurotransmitter at sympathetic ganglia.

The postganglionic neurone: This has its cell body in a ganglion and terminates in the organ or tissue supplied. Noradrenaline (norepinephrine) is usually the neurotransmitter at sympathetic effector organs. The major exception is that there is no parasympathetic supply to the sweat glands, the skin and blood vessels of skeletal muscles. These structures are supplied by only sympathetic postganglionic neurones, which are known as sympathetic cholinergic nerves and usually have acetylcholine as their neurotransmitter (see Fig. 7.8).

Sympathetic ganglia The lateral chains of sympathetic ganglia

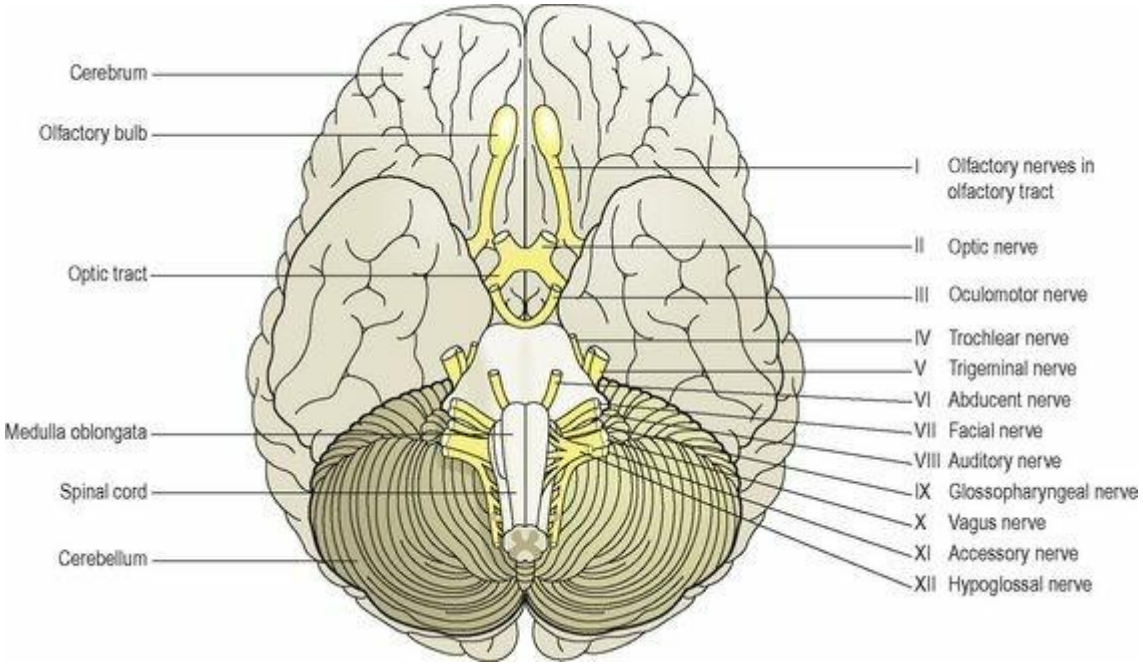
These chains extend from the upper cervical level to the sacrum, one chain lying on each side of the vertebral bodies. The ganglia are attached to each other by nerve fibres. Preganglionic neurones that emerge from the cord may synapse with the cell body of the postganglionic neurone at the same level or they may pass up or down the chain through

one or more ganglia before synapsing. For example, the nerve that dilates the pupil of the eye leaves the cord at the level of the 1st thoracic vertebra and passes up the chain to the superior cervical ganglion before it synapses with the cell body of the postsynaptic neurone. The postganglionic neurones then pass to the eyes. The arrangement of the ganglia allows excitation of nerves at multiple levels very quickly,
providing a rapid and widespread sympathetic response.

Prevertebral ganglia: There are three prevertebral ganglia situated in the abdominal cavity close to the origins of arteries of the same names: coeliac ganglion superior mesenteric ganglion inferior mesenteric ganglion. The ganglia consist of nerve cell bodies rather diffusely distributed among a network of nerve fibres that form plexuses. Preganglionic sympathetic fibres pass through the lateral chain to reach these ganglia.

19. What is the origin and functions of cranial nerves?

Ans: Figure 7.43 The inferior surface of the brain showing the cranial nerves and



associated structures.

There are 12 pairs of cranial nerves originating from nuclei in the inferior surface of the brain, some sensory, some motor and some mixed. Their names generally suggest their distribution or function and they are numbered using Roman numerals according to the order they connect to the brain, starting anteriorly. They are: I.Olfactory: sensory, II. Optic: sensory, III. Oculomotor: motor, IV. Trochlear: motor, Trigeminal: mixed, VI. Abducent: motor, VII. Facial: mixed, VIII. Vestibulocochlear (auditory): sensory, IX. Glossopharyngeal: mixed, X. Vagus: mixed, XI. Accessory: motor, XII. Hypoglossal: motor.

I Olfactory nerves (sensory): These are the nerves of the *sense of smell*. Their sensory receptors and fibres originate in the upper part of the mucous membrane of the nasal cavity, pass upwards through the cribriform plate of the ethmoid bone and then pass to the *olfactory bulb* (see Fig. 8.24, p. 200). The nerves then proceed backwards as the

olfactory tract, to the area for the perception of smell in the temporal lobe of the cerebrum.

II Optic nerves (sensory): These are the nerves of the *sense of sight*. The fibres originate in the retinae of the eyes and they combine to form the optic nerves (see Fig. 8.13, p. 194). They are directed backwards and medially through the posterior part of the orbital cavity. They then pass through the *optic foramina* of the sphenoid bone into the cranial cavity and join at the *optic chiasma*. The nerves proceed backwards as the *optic tracts* to the *lateral geniculate bodies* of the thalamus. Impulses pass from there to the visual areas in the occipital lobes of the cerebrum and to the cerebellum. In the occipital lobe sight is perceived, and in the cerebellum the impulses from the eyes contribute to the maintenance of balance, posture and orientation of the head in space.

III Oculomotor nerves (motor): These nerves arise from nuclei near the cerebral aqueduct. They supply: four of the six extrinsic muscles, which move the eyeball, i.e. the *superior*, *medial* and *inferior recti* and the *inferior oblique muscle* the intrinsic (intraocular) muscles: – *ciliary muscles*, which alter the shape of the lens, changing its refractive power – *circular muscles* of the iris, which constrict the pupil the *levator palpebrae muscles*, which raise the upper eyelids.

IV Trochlear nerves (motor): These nerves arise from nuclei near the cerebral aqueduct. They supply the *superior oblique muscles* of the eyes.

V Trigeminal nerves (mixed): These nerves contain motor and sensory fibres and are among the largest of the cranial nerves. They are the chief sensory nerves for the face and head (including the oral and nasal cavities and teeth), receiving impulses of pain, temperature and touch. The motor fibres stimulate the muscles of mastication. As the name suggests, there are three main branches of the trigeminal nerves. The dermatomes innervated by the sensory fibres on the right side. The cutaneous distribution of the main branches of the right trigeminal nerve. *The ophthalmic nerves* are sensory only and supply the lacrimal glands, conjunctiva of the eyes, forehead, eyelids, anterior aspect of the scalp and mucous membrane of the nose. *The maxillary nerves* are sensory only and supply the cheeks, upper gums, upper teeth and lower eyelids. *The mandibular nerves* contain both sensory and motor fibres. These are the largest of the three divisions and they supply the teeth and gums of the lower jaw, pinnae of the ears, lower lip and tongue. The motor fibres supply the muscles of mastication (chewing).

VI Abducent nerves (motor): These nerves arise from nuclei lying under the floor of the fourth ventricle. They supply the *lateral rectus muscles* of the eyeballs causing abduction, as the name suggests.

VII Facial nerves (mixed): These nerves are composed of both motor and sensory nerve fibres, arising from nuclei in the lower part of the pons. The motor fibres supply the muscles of facial expression. The sensory fibres convey impulses from the taste buds in the anterior two-thirds of the tongue to the taste perception area in the cerebral cortex.

VIII Vestibulocochlear (auditory) nerves (sensory): These nerves are composed of two divisions, the vestibular nerves and cochlear nerves. *The vestibular nerves* arise from the semicircular canals of the inner ear and convey impulses to the cerebellum. They are associated with the maintenance of posture and balance. *The cochlear nerves* originate in

the spiral organ (of Corti) in the inner ear and convey impulses to the hearing areas in the cerebral cortex where sound is perceived.

IX Glossopharyngeal nerves (mixed): The motor fibres arise from nuclei in the medulla oblongata and stimulate the muscles of the tongue and pharynx and the secretory cells of the parotid (salivary) glands. The sensory fibres convey impulses to the cerebral cortex from the posterior third of the tongue, the tonsils and pharynx and from taste buds in the tongue and pharynx. These nerves are essential for the swallowing and gag reflexes. Some fibres conduct impulses from the carotid sinus, which plays an important role in the control of blood pressure.

X Vagus nerves (mixed): These nerves have a more extensive distribution than any other cranial nerves and their name aptly means 'wanderer'. They pass down through the neck into the thorax and the abdomen. These nerves form an important part of the parasympathetic nervous system

XI Accessory nerves (motor): These nerves arise from nuclei in the medulla oblongata and in the spinal cord. The fibres supply the *sternocleidomastoid* and *trapezius muscles*. Branches join the vagus nerves and supply the *pharyngeal* and *laryngeal muscles*.

XII Hypoglossal nerves (motor): These nerves arise from nuclei in the medulla oblongata. They supply the muscles of the tongue and muscles surrounding the hyoid bone and contribute to swallowing and speech.

20. Explain Structure and functions of eye and their disorders?

Ans: The eye is the organ of sight. It is situated in the orbital cavity and supplied by the *optic nerve*

(2nd cranial nerve). It is almost spherical in shape and about 2.5 cm in diameter. The space between the eye and the orbital cavity is occupied by adipose tissue. The bony walls of the orbit and the fat help to protect the

eye from injury. Structurally the two eyes are separate but, unlike the ear, some of their activities are coordinated so that they function as a pair. It is possible to see with only one eye (monocular vision), but threedimensional vision is impaired when only one eye is used, especially in relation to the judgement of speed and distance. **Structure (Fig. 8.8)**There are three layers of tissue in the walls of the eye: the outer fibrous layer: sclera and cornea the middle vascular layer or *uveal tract*: consisting of the choroid, ciliary body and iris the inner nervous tissue layer: retina.

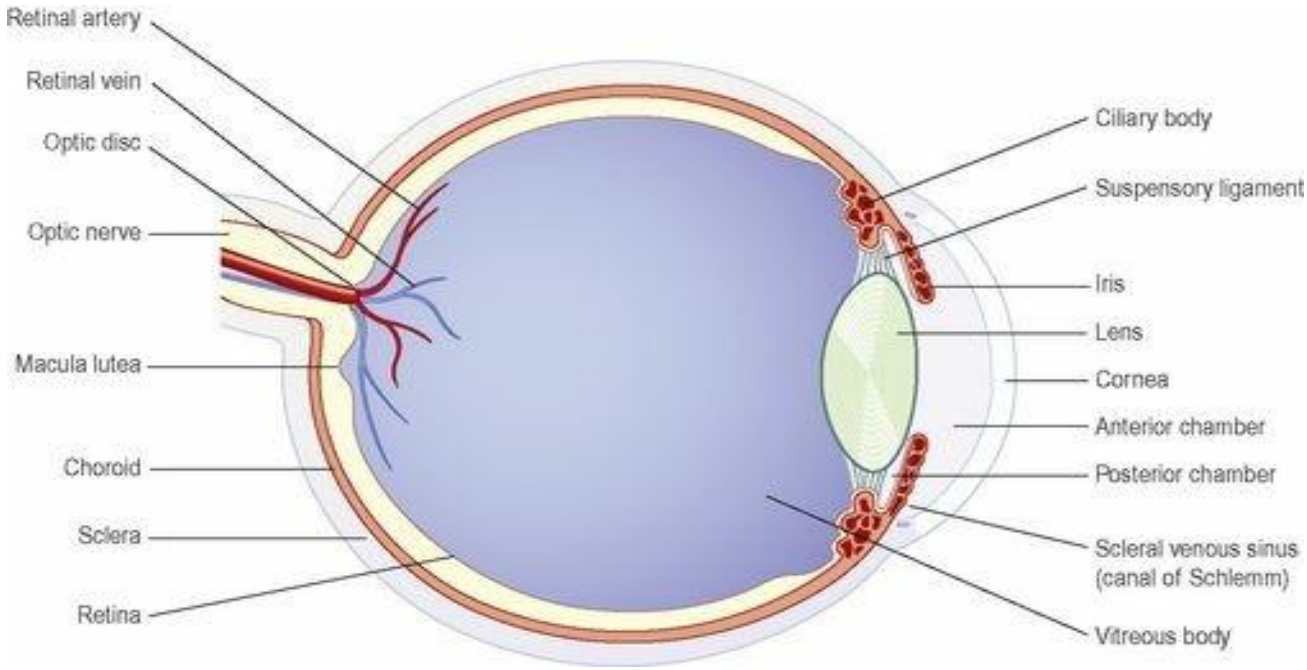


Figure 8.8 Section of the eye.

Structures inside the eyeball include the lens, aqueous fluid and vitreous body.

Sclera and cornea: The sclera, or white of the eye, forms the outermost layer of the posterior and lateral aspects of the eyeball and is continuous anteriorly with the transparent cornea. It consists of a firm fibrous membrane that maintains the shape of the eye and gives attachment to the *extrinsic muscles* of the eye. Anteriorly the sclera continues as a clear transparent epithelial membrane, the cornea. Light rays pass through the cornea to reach the retina. The cornea is convex anteriorly and is involved in refracting (bending) light rays to focus them on the retina. **Choroid (Figs 8.8 and 8.9):** The choroid lines the posterior five-sixths of the inner surface of the sclera. It is very rich in blood vessels and is deep chocolate brown in colour. Light enters the eye through the pupil, stimulates the sensory receptors in the retina and is then absorbed by the choroid.

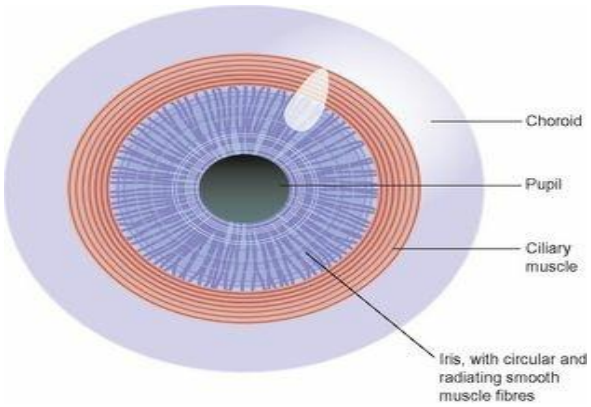


Figure 8.9 The choroid, ciliary body and iris. Viewed from thefront

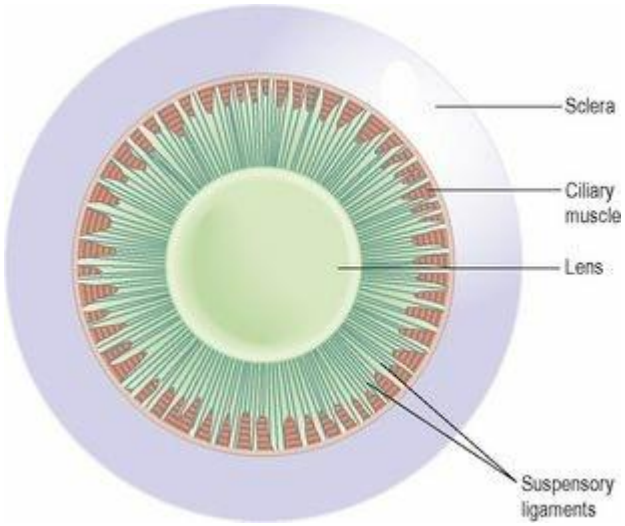


Figure 8.10 The lens and suspensory ligaments viewed from the front. The iris has been removed.

Ciliary body: The ciliary body is the anterior continuation of the choroid consisting of *ciliary muscle* (smooth muscle fibres) and secretory epithelial cells. As many of the smooth muscle fibres are circular, the ciliary muscle acts like a sphincter. The lens is attached to the ciliary body by radiating *suspensory ligaments*, like the spokes of a wheel (see Fig. 8.10). Contraction and relaxation of the ciliary muscle fibres, which are attached to these ligaments, control the shape of the lens. The epithelial cells secrete *aqueous fluid* into the anterior segment of the eye, i.e. the space between the lens and the cornea (anterior and posterior chambers) (Fig. 8.8). The ciliary body is supplied by parasympathetic branches of the oculomotor nerve (3rd cranial nerve). Stimulation causes contraction of the ciliary muscle and accommodation of the eye.

Iris: The iris is the visible coloured part of the eye and extends anteriorly from the ciliary body, lying behind the cornea and in front of the lens. It divides the *anterior segment* of the eye into anterior and posterior chambers which contain aqueous fluid secreted by the ciliary body. It is a circular body composed of pigment cells and two layers of smooth muscle fibres, one circular and the other radiating (Fig. 8.9). In the centre is an aperture called the *pupil*. The iris is supplied by parasympathetic and sympathetic nerves. Parasympathetic stimulation constricts the pupil and sympathetic stimulation dilates it. The colour of the iris is genetically determined and depends on the number of pigment cells present. Albinos have no pigment cells and people with blue eyes have fewer than those with brown eyes.

Lens (Fig. 8.10): The lens is a highly elastic circular biconvex body, lying immediately behind the pupil. It consists of fibres enclosed within a capsule and it is suspended from the ciliary body by the suspensory ligament. Its thickness is controlled by the ciliary muscle through the suspensory ligament. When the ciliary muscle contracts, it moves forward, releasing its pull on the lens, increasing its thickness. The nearer is the object being viewed, the thicker the lens becomes to allow focusing. The lens bends (refracts) light rays reflected by objects in front of the eye. It is the only structure in the eye that can vary its refractory power, which is achieved by changing its thickness.

Retina: The retina is the innermost layer of the wall of the eye (Fig. 8.8). It is an extremely delicate structure and is well adapted for stimulation by light rays. It is composed of several layers of nerve cell bodies and their axons, lying on a pigmented layer of epithelial cells which attach it to the choroid. The lightsensitive layer consists of sensory receptor cells, *rods* and *cones*, which contain photosensitive pigments that convert light rays into nerve impulses. The retina lines about three-quarters of the eyeball and is thickest at the back. It thins out anteriorly to end just behind the ciliary body. Near the centre of the posterior part is the *macula lutea*, or yellow spot (Figs 8.11 and 8.12). In the centre of the yellow spot is a little depression called the *fovea centralis*, consisting of only cones. Towards the anterior part of the retina there are fewer cones than rods (Fig. 8.11).

21.Explain conduction system of heart?

Ans: The heart possesses the property of *autorhythmicity*, which means it generates its own electrical impulses and beats independently of nervous or hormonal control, i.e. it is not reliant on external mechanisms to initiate each heartbeat. However, it is supplied with both sympathetic and parasympathetic autonomic nerve fibres, which increase and decrease respectively the intrinsic heart rate. In addition, the heart responds to a number of circulating hormones, including adrenaline (epinephrine) and thyroxine. Small groups of specialised neuromuscular cells in the myocardium initiate and conduct impulses, causing coordinated and synchronised contraction of the heart muscle (Fig. 5.19).

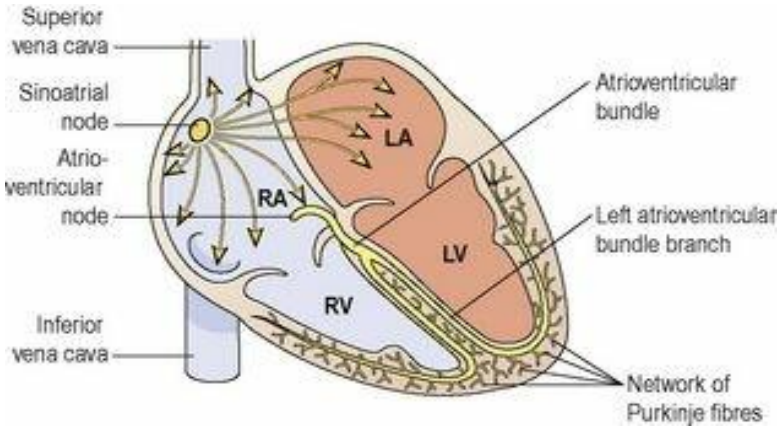


Figure 5.19 The conducting system of the heart.

Sinoatrial node (SA node): This small mass of specialised cells lies in the wall of the right atrium near the opening of the superior vena cava. The sinoatrial cells generate these regular impulses because they are electrically unstable. This instability leads them to discharge (*depolarise*) regularly, usually between 60 and 80 times a minute. This depolarisation is followed by recovery (*repolarisation*), but almost immediately their instability leads them to discharge again, setting the heart rate. Because the SA node discharges faster than any other part of the heart, it normally sets the heart rate and is called the *pacemaker* of the heart. Firing of the SA node triggers atrial contraction.

Atrioventricular node (AV node): This small mass of neuromuscular tissue is situated in the wall of the atrial septum near the atrioventricular valves. Normally, the AV node

merely transmits the electrical signals from the atria into the ventricles. There is a delay here; the electrical signal takes 0.1 of a second to pass through into the ventricles. This allows the atria to finish contracting before the ventricles start. The AV node also has a secondary pacemaker function and takes over this role if there is a problem with the SA node itself, or with the transmission of impulses from the atria. Its intrinsic firing rate, however, is slower than that set by the SA node (40–60 bpm).

Atrioventricular bundle (AV bundle or bundle of His): This is a mass of specialised fibres that originate from the AV node. The AV bundle crosses the fibrous ring that separates atria and ventricles then, at the upper end of the ventricular septum, it divides into *right* and *left bundle branches*. Within the ventricular myocardium the branches break up into fine fibres, called the *Purkinje fibres*. The AV bundle, bundle branches and Purkinje fibres transmit electrical impulses from the AV node to the apex of the myocardium where the wave of ventricular contraction begins, then sweeps upwards and outwards, pumping blood into the pulmonary artery and the aorta.

Nerve supply to the heart: As mentioned earlier, the heart is influenced by autonomic (sympathetic and parasympathetic) nerves originating in the *cardiovascular centre* in the *medulla oblongata*. The *vagus nerves* (parasympathetic) supply mainly the SA and AV nodes and atrial muscle. Parasympathetic stimulation reduces the rate at which impulses are produced, decreasing the rate and force of the heartbeat. The *sympathetic nerves* supply the SA and AV nodes and the myocardium of atria and ventricles. Sympathetic stimulation *increases* the rate and force of the heartbeat.

22.Explain anatomy of heart?

Ans: Structure

The heart wall: The heart wall is composed of three layers of tissue (Fig. 5.11): pericardium, myocardium and endocardium.

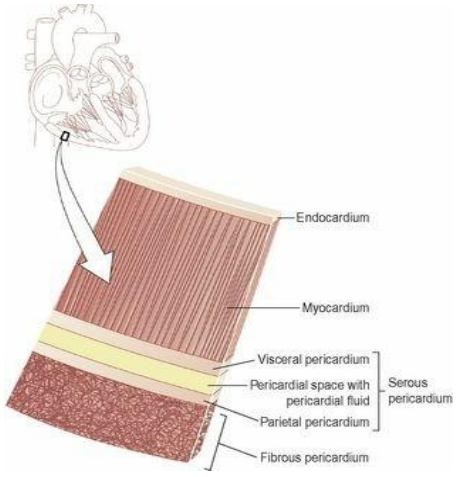


Figure 5.11 Layers of the heart wall.

Pericardium: The pericardium is the outermost layer and is made up of two sacs. The outer sac consists of fibrous tissue and the inner of a continuous double layer of serous membrane. The outer fibrous sac is continuous with the tunica adventitia of the great blood vessels above and is adherent to the diaphragm below. Its inelastic, fibrous nature prevents overdistension of the heart. The outer layer of the serous membrane, the *parietal pericardium*, lines the fibrous sac. The inner layer, the *visceral pericardium*, or

epicardium, which is continuous with the parietal pericardium, is adherent to the heart muscle. A similar arrangement of a double membrane forming a closed space is seen also with the pleura, the membrane enclosing the lungs (see Fig. 10.15, p. 243). The serous membrane consists of flattened epithelial cells. It secretes serous fluid into the space between the visceral and parietal layers, which allows smooth movement between them when the heart beats. The space between the parietal and visceral pericardium is only a *potential space*. In health the two layers lie closely together, with only the thin film of serous fluid between them.

Myocardium: The myocardium is composed of specialised cardiac muscle found only in the heart (Fig. 5.12). It is not under voluntary control but is striated, like skeletal muscle. Each fibre (cell) has a nucleus and one or more branches. The ends of the cells and their branches are in very close contact with the ends and branches of adjacent cells. Microscopically these 'joints', or *intercalated discs*, are thicker, darker lines than the striations. This arrangement gives cardiac muscle the appearance of being a sheet of muscle rather than a very large number of individual cells. Because of the end-to-end continuity of the fibres, each one does not need to have a separate nerve supply. When an impulse is initiated it spreads from cell to cell via the branches and intercalated discs over the whole 'sheet' of muscle, causing contraction. The 'sheet' arrangement of the myocardium enables the atria and ventricles to contract in a coordinated and efficient manner. Running through the myocardium is also the network of specialised conducting fibres responsible for transmitting the heart's electrical signals. The myocardium is thickest at the apex and thins out towards the base (Fig. 5.13). This reflects the amount of work each chamber contributes to the pumping of blood. It is thickest in the left ventricle, which has the greatest workload.

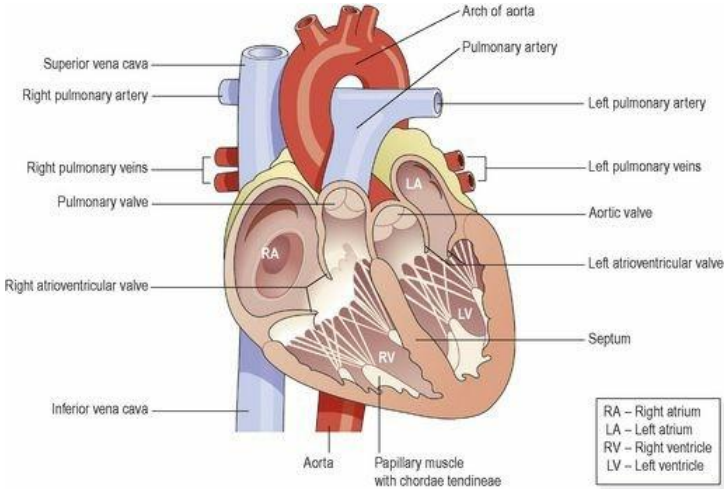


Figure 5.13 Interior of the heart.

Fibrous tissue in the heart: The myocardium is supported by a network of fine fibres that run through all the heart muscle. This is called the *fibrous skeleton* of the heart. In addition, the atria and the ventricles are separated by a ring of fibrous tissue, which does not conduct electrical impulses. Consequently, when a wave of electrical activity passes over the atrial muscle, it can only spread to the ventricles through the conducting system that bridges the fibrous ring from atria to ventricles.

Endocardium: This lines the chambers and valves of the heart. It is a thin, smooth, glistening membrane that permits smooth flow of blood inside the heart. It consists of flattened epithelial cells, and it is continuous with
the endothelium lining the blood vessels.

Interior of the heart: The heart is divided into a right and left side by the *septum* (Fig. 5.13), a partition consisting of myocardium covered by endocardium. After birth, blood cannot cross the septum from one side to the other. Each side is divided by an *atrioventricular valve* into the upper atrium and the ventricle below. The atrioventricular valves are formed by double folds of endocardium strengthened by a little fibrous tissue. The *right atrioventricular valve* (tricuspid valve) has three flaps or cusps and the left atrioventricular valve (mitral valve) has two cusps. Flow of blood in the heart is one way; blood enters the heart via the atria and passes into the ventricles below. The valves between the atria and ventricles open and close passively according to changes in pressure in the chambers. They open when the pressure in the atria is greater than that in the ventricles. During *ventricular systole* (contraction) the pressure in the ventricles rises above that in the atria and the valves snap shut, preventing backward flow of blood. The valves are prevented from opening upwards into the atria by tendinous cords, called *chordae tendineae*, which extend from the inferior surface of the cusps to little projections of myocardium into the ventricles, covered with endothelium, called *papillary muscles*.

Flow of blood through the heart (Fig. 5.15): The two largest veins of the body, the *superior* and *inferior venae cavae*, empty their contents into the right atrium. This blood passes via the right atrioventricular valve into the right ventricle, and from there is pumped into the *pulmonary artery* or *trunk* (the only artery in the body which carries deoxygenated blood). The opening of the pulmonary artery is guarded by the *pulmonary valve*, formed by three *semilunar cusps*. This valve prevents the backflow of blood into the right ventricle when the ventricular muscle relaxes. After leaving the heart the pulmonary artery divides into *left* and *right pulmonary arteries*, which carry the venous blood to the lungs where exchange of gases takes place: carbon dioxide is excreted and oxygen is absorbed.

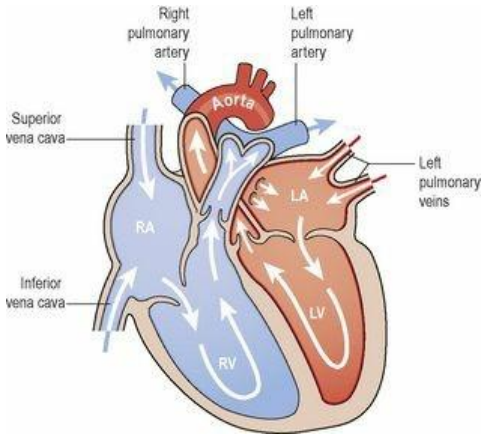


Figure 5.15 Direction of blood flow through the heart.

Two *pulmonary veins* from each lung carry *oxygenated blood* back to the *left atrium*. Blood then passes through the left atrioventricular valve into the left ventricle, and from

there it is pumped into the aorta, the first artery of the general circulation. The opening of the aorta is guarded by the *aortic valve*, formed by three *semilunar cusps* (Fig. 5.16).

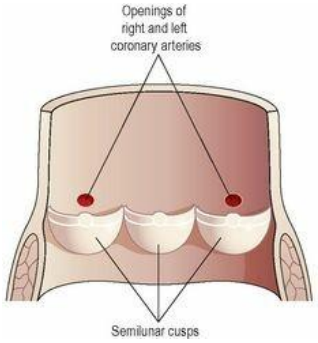


Figure 5.16 The aorta cut open to show the semilunar cusps of the aortic valve.

From this sequence of events it can be seen that the blood passes from the right to the left side of the heart via the lungs, or pulmonary circulation (Fig. 5.17). However, it should be noted that both atria contract at the same time and this is followed by the simultaneous contraction of both ventricles.

23. Explain regulation process of blood pressure?

Ans: Blood pressure is the force or pressure that the blood exerts on the walls of the blood vessels. Systemic arterial blood pressure maintains the essential flow of blood into and out of the organs of the body. Keeping blood pressure within normal limits is very important. If it becomes too high, blood vessels can be damaged, causing clots or bleeding from sites of blood vessel rupture. If it falls too low, then blood flow through tissue beds may be inadequate. This is particularly dangerous for such essential organs as the heart, brain or kidneys.

The systemic arterial blood pressure, usually called simply arterial blood pressure, is the result of the discharge of blood from the left ventricle into the already full aorta. Blood pressure varies according to the time of day, the posture, gender and age of the individual. Blood pressure falls at rest and during sleep. It increases with age and is usually higher in women than in men.

Systolic and diastolic pressure: When the left ventricle contracts and pushes blood into the aorta, the pressure produced within the arterial system is called the *systolic blood pressure*. In adults it is about 120 mmHg or 16 kPa. When *complete cardiac diastole* occurs and the heart is resting following the ejection of blood, the pressure within the arteries is much lower and is called *diastolic blood pressure*. In an adult this is about 80 mmHg or 11 kPa. The difference between systolic and diastolic blood pressures is the *pulse pressure*. Arterial blood pressure is measured with a *sphygmomanometer* and is usually expressed with the systolic pressure written above the diastolic pressure:

Elasticity of arterial walls: There is a considerable amount of elastic tissue in the arterial walls, especially in large arteries. Therefore, when the left ventricle ejects blood into the already full aorta, the aorta expands to accommodate it, and then recoils because of the elastic tissue in the wall. This pushes the blood forwards, into the systemic circulation. This distension and recoil occurs throughout the arterial system. During cardiac diastole the elastic recoil of the arteries maintains the diastolic pressure (Fig. 5.21).

Factors determining blood pressure: Blood pressure is determined by *cardiac output* and *peripheral resistance*. Change in either of these parameters tends to alter systemic blood pressure, although the body's compensatory mechanisms usually adjust for any significant change.

$$\text{Blood pressure} = \text{Cardiac output} \times \text{Peripheral resistance}$$

Cardiac output: Cardiac output is determined by the stroke volume and the heart rate (p. 85). Factors that affect the heart rate and stroke volume are described above, and they may increase or decrease cardiac output and, in turn, blood pressure. An increase in cardiac output raises both systolic and diastolic pressures. An increase in stroke volume increases systolic pressure more than it does diastolic pressure.

Peripheral or arteriolar resistance: Arterioles are the smallest arteries and they have a tunica media composed almost entirely of smooth muscle, which responds to nerve and chemical stimulation. Constriction and dilation of the arterioles are the main determinants of peripheral resistance. Vasoconstriction causes blood pressure to rise and vasodilation causes it to fall. When elastic tissue in the tunica media is replaced by inelastic fibrous tissue as part of the ageing process, blood pressure rises.

Autoregulation: Systemic blood pressure rises and falls constantly, according to levels of activity, body position, etc. However, the organs of the body are capable of adjusting blood flow and blood pressure in their own local vessels independently of systemic blood pressure. This property is called *autoregulation*, and protects the tissues against swings in systemic pressures. It is especially important in the kidneys, which can be damaged by increased pressure in their delicate glomerular capillary beds, and in the brain, which is very sensitive to even slight levels of cellular waste.

Control of blood pressure (BP) Blood pressure is controlled in two ways:

short-term control, on a moment-to-moment basis, which mainly involves the baroreceptor reflex, discussed below, and also chemoreceptors and circulating hormones

long-term control, which involves regulation of blood volume by the kidneys and the renin– angiotensin– aldosterone system (p. 338).

Short-term blood pressure regulation:

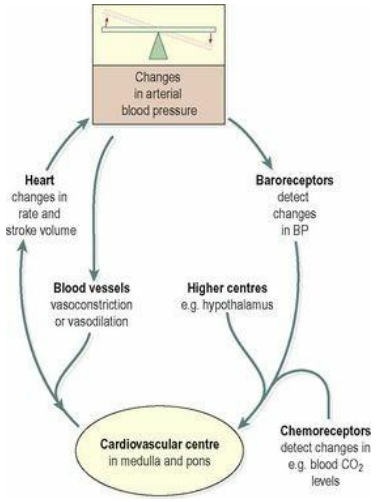


Figure 5.24 Summary of the main mechanisms in blood pressure control.

The cardiovascular centre (CVC) is a collection of interconnected neurones in the medulla and pons of the brain stem. The CVC receives, integrates and coordinates inputs from: baroreceptors (pressure receptors), chemoreceptors higher centres in the brain.

The CVC sends autonomic nerves (both sympathetic and parasympathetic) to the heart and blood vessels. It controls BP by slowing down or speeding up the heart rate and by dilating or constricting blood vessels.

Activity in these fibres is essential for control of blood pressure (Fig. 5.24). The two divisions of the autonomic nervous system, the sympathetic and the parasympathetic divisions,

Baroreceptors: These are nerve endings sensitive to pressure changes (stretch) within the vessel, situated in the arch of the aorta and in the carotid sinuses (Fig. 5.25), and are the body's principal moment-to-moment regulatory mechanism for controlling blood pressure. A rise in blood pressure in these arteries stimulates the baroreceptors, increasing their input to the CVC. The CVC responds by increasing parasympathetic nerve activity to the heart; this slows the heart down. At the same time, sympathetic stimulation to the blood vessels is inhibited, causing vasodilation. The net result is a fall in systemic blood pressure. Conversely, if pressure within the aortic arch and carotid sinuses falls, the rate of baroreceptor discharge also falls. The CVC responds by increasing sympathetic drive to the heart to speed it up. Sympathetic activity in blood vessels is also increased, leading to vasoconstriction. Both these measures counteract the falling blood pressure.

Baroreceptor control of blood pressure is also called the *baroreceptor reflex* (Fig. 5.25).

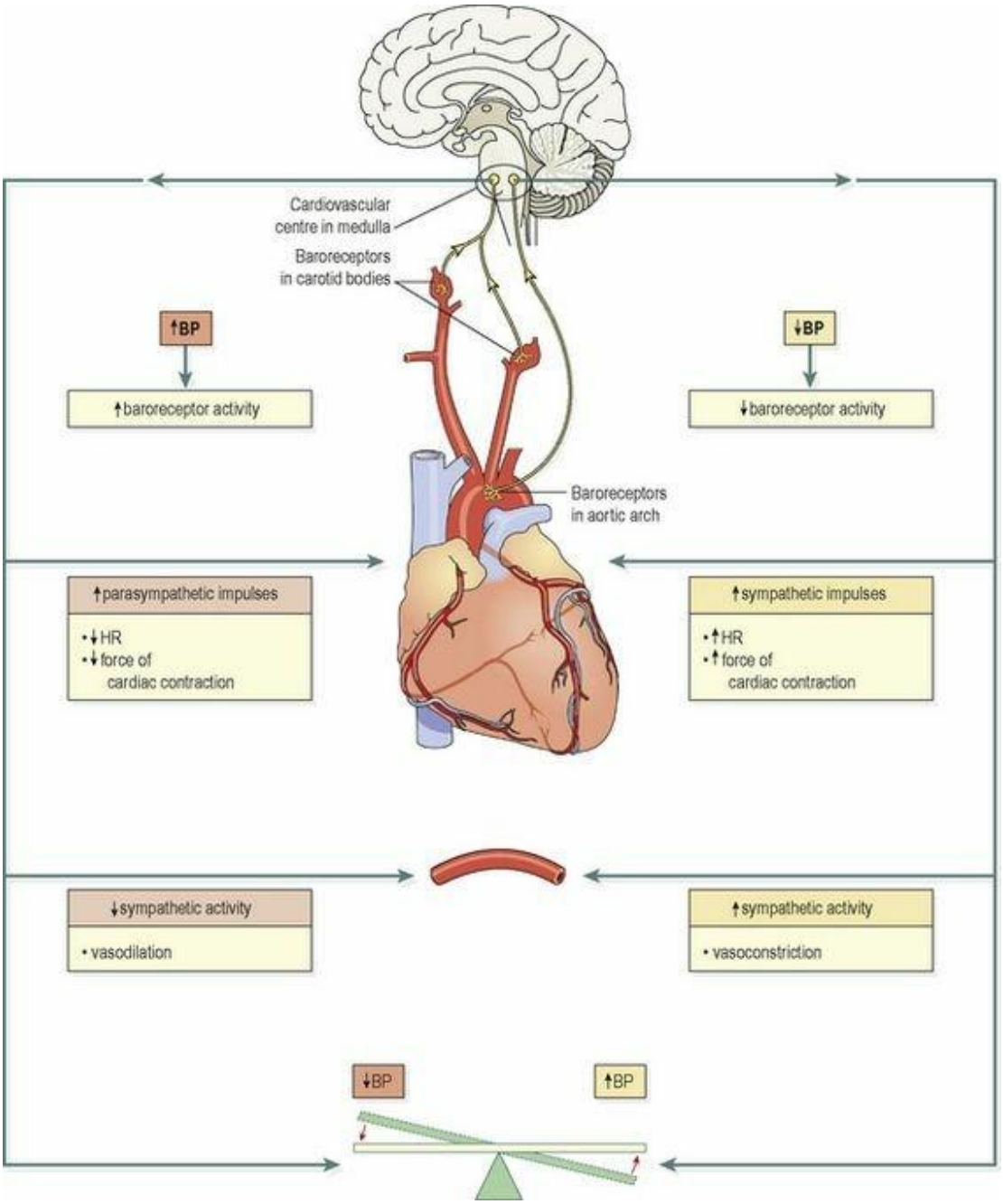


Figure 5.25 The baroreceptor reflex.

Chemoreceptors: These are nerve endings situated in the carotid and aortic bodies, and are primarily involved in control of respiration (p. 252). They are sensitive to changes in the levels of carbon dioxide, oxygen and the acidity of the blood (pH) (Fig. 5.26). Rising blood CO2, falling blood O2 levels and/or falling

pH all indicate failing tissue perfusion. When these changes are detected by the chemoreceptors, they send signals to the CVC, which then increases sympathetic drive to the heart and blood vessels, pushing blood pressure up to improve tissue blood supply. Because respiratory effort is also stimulated, blood oxygen levels rise as well.

Chemoreceptor input to the CVC influences its output only when severe disruption of respiratory function occurs or when arterial BP falls to less than 80 mmHg. Similar

chemoreceptors are found on the brain surface in the medulla oblongata, and they measure carbon dioxide/oxygen levels and pH of the surrounding cerebrospinal fluid. Changes from normal activate responses similar to those described above for the aortic/carotid receptors.

Higher centres in the brain: Input to the CVC from the higher centres is influenced by emotional states such as fear, anxiety, pain and anger that may stimulate changes in blood pressure. The hypothalamus in the brain controls body temperature and influences the CVC, which responds by adjusting the diameter of blood vessels in the skin – an important mechanism in determining heat loss and retention.

Long-term blood pressure regulation: Long-term blood pressure control is mainly exerted by the *renin–angiotensin–aldosterone* system (RAAS, see p. 338) and the action of *antidiuretic hormone* (ADH, see p. 335). Both of these systems regulate blood volume, thus influencing blood pressure. In addition, *atrial natriuretic peptide* (ANP), a hormone released by the heart itself, causes sodium and water loss from the kidney and reduces blood pressure, opposing the activities of both ADH and the RAAS.

Pressure in the pulmonary circulation: Pulmonary blood pressure is much lower than in the systemic circulation, because although the lungs receive the same amount of blood from the right ventricle as the rest of the body receives from the left ventricle, there are so many capillaries in the lungs that pressure is kept low. If pulmonary capillary pressure exceeds 25 mmHg, fluid is forced out of the bloodstream and into the airsacs (*pulmonary oedema*), with very serious consequences. Autoregulation in the pulmonary circulation makes sure that blood flow through the vast network of capillaries is directed through well-oxygenated airsacs.

24. Explain the terms cardiac output & cardiac cycle?

Ans: The cardiac output is the amount of blood ejected from each ventricle every minute. The amount expelled by each contraction of each ventricle is the *stroke volume*. Cardiac output is expressed in litres per minute (l/min) and is calculated by multiplying the stroke volume by the heart rate (measured in beats per minute): In a healthy adult at rest, the stroke volume is approximately 70 ml and if the heart rate is 72 per minute, the cardiac output is 5 l/minute. This can be greatly increased to meet the demands of exercise to around 25 l/minute, and in athletes up to 35 l/minute. This increase during exercise is called the *cardiac reserve*. When increased blood supply is needed to meet increased tissue requirements of oxygen and nutrients, heart rate and/or stroke volume can be increased.

Assignment No- 1 [A.Y. 2020-21]

Unit: 1&2 **Class: B.Pharm. (Sem.I)**
Subject: Human Anatomy & Physiology -I (BP101T) **Total Marks: 20**

Q. No.	Questions	Max. Marks	Unit no.	CO Mapped	Bloom's Taxonomy Level
01.	What is mean by anatomy & physiology?	04	1	1	2
02.	Explain different transport mechanism across cell membrane?	04	1	1	2
03.	Explain stricture & functions of connective & muscular tissue?	04	1	1	2
04.	Classify different types of bones?	04	2	3	1
05.	Explain different types of joint movement?	04	2	1	2

Assignment No- 2 [A.Y. 2020-21]

Unit: 3,4 &5 **Class: B.Pharm. (Sem.I)**
Subject: Human Anatomy & Physiology -I (BP101T) **Total Marks: 20**

Question No.	Questions	Max. Marks	Unit no.	CO Mapped	Bloom's Taxonomy Level
1	Explain mechanisms of coagulation?	04	3	2	2
2	What are different blood groups?	04	3	4	2
3	Differentiate between sympathetic and parasympathetic nervous system?	04	4	1	2
4	Write down structure of ear?	04	4	1	2
5	Explain conduction system of heart?	04	5	2	2

Class Test- 1 [A.Y. 2020-21]

Unit: 1&2 **Class: B.Pharm. (Sem.I)**
Subject: Human Anatomy & Physiology -I (BP101T) **Total Marks: 30**

Question No.	Questions	Max. Marks	Unit no.	CO Mapped	Bloom's Taxonomy Level
01.	Explain level of Structural organization?	05	1	1	2
02.	Classify different types of tissue & write down structure & functions of epithelial tissue ?	05	1	1	2
03.	Explain different forms of intracellular signalling pathway ?	05	1	1	2
04.	Describe in detail structure & function of cell	05	2	1	2
05.	Explain neuromuscular junction	05	2	2	2
06.	Write down structural & functional classification of joints	05	2	3	4

Class Test- 2 [A.Y. 2020-21]

Unit: 3,4 &5 **Class: B.Pharm. (Sem.I)**
Subject: Human Anatomy & Physiology -I (BP101T) **Total Marks: 30**

Question No.	Questions	Max. Marks	Unit no.	CO Mapped	Bloom's Taxonomy Level
01.	Write down composition & functions of blood?	05	3	4	2
02.	Explain lymphatic system & its function?	05	3	4	2
03.	Write down names & functions of spinal and cranial nerves?	05	4	1	2
04.	Write down structure and functions of eye?	05	4	1	2
05.	Explain anatomy & blood circulation of heart?	05	5	2	2
06.	What is mean by cardiac output & cardiac cycle?	05	5	3	4

University Question Papers

Total No. of Questions : 3] SEAT No. :

P3705 [Total No. of Pages : 4

[5452]-2001

F.Y. B. Pharmacy (Semester - I)

HUMAN ANATOMY AND PHYSIOLOGY - I

(2018 Pattern)

Time : 3 Hours] *[Max. Marks : 75*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Neat labeled diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*

Q1) Answer all the questions (MCQs) (one mark each) **[20 × 1 = 20]** CO1

i) Left atrioventricular aperture is guarded by _____.

a) Tricuspid valve b) Eustachian tube

c) Bicuspid valve d) Semilunar valve

ii) Atrioventricular node is located in _____.

a) Left atrium b) Left ventricle

c) Right Atrium d) Right ventricle

iii) QRS is related to

a) Atrial contraction b) Ventricular contraction

c) Atrial relaxation d) Ventricular relaxation

iv) The deposition of fatty substance in the lining of arteries is called _____.

a) Arteriosclerosis b) Atherosclerosis

c) Angina pectoris d) Angiology

v) When oxygen-rich blood leaves the lungs for the heart, it enters the heart through the pulmonary vein into the _____.

a) left ventricle b) right atrium

c) right ventricle d) left atrium

P.T.O.

vi) The blood vessel that carries deoxygenated blood from the body to the right side of the heart is called the _____.

a) Pulmonary vein b) Aorta

c) Pulmonary artery d) Vena cava

vii) A spleen nodule contains _____.

a) The factory that produces platelets

b) Reservoir of glucose stored as glycogen

c) Red pulp and white pulp

d) Hormone producing islets

viii) A condition in which the body internal environment remains relatively constant with physiological limit i.e. equilibrium is called as _____.

a) Erythropoiesis b) Homeostasis

c) Hemostasis d) Metastasis

ix) The net movement of solvent through selectively permeable membrane from area of higher concentration to area of lower concentration is called as _____?

a) Diffusion b) Osmosis

c) Facilitated diffusion d) Active Transport

x) The tissue that lines the hollow organ of the human body is called as _____.

a) Epithelial tissue b) Muscle tissue

c) Connective tissue d) Nervous tissue

xi) _____ muscle is voluntary in nature.

a) Cardiac muscle b) Smooth muscle

c) Skeletal muscle d) None of the above

xii) This is the (4.5 – 6.5 millions/cumm of blood) normal count of _____.

a) RBC b) WBC

c) Platelets d) None of the above

xiii) What type of antigen are present on the RBC of a person having blood group 'O'

a) Antigen A b) Antigen B

c) Antigen AB d) No Antigen

xiv) The superficial layer of the epidermis from which cells are continuously shed is called the _____.

a) stratum granulosum b) stratum spinosum

c) stratum corneum d) stratum basale

xv) Example of ball and socket joint is _____.

a) Vertebral disc joint b) Knee and Elbow joint

c) Shoulder and hip joint d) Saddle joint

xvi) Which of the following is not regulated by a negative feedback mechanism?

a) Blood O_2 levels b) Child birth

c) Blood pressure d) Body temperature

xvii) The Elbow is described as being _____ to the wrist.

a) Proximal b) Lateral

c) Anterior d) Distal

xviii) The sympathetic nervous system is also known as _____.

a) Rest and digest b) Craniosacral division of ANS

c) Somatic nervous system d) Fight or Flight

xix) Blood is a _____ tissue composed of liquid portion called plasma and a cellular portion consisting of various cells and cell fragments.

a) Epithelial b) Connective

c) Nervous d) Muscle

xx) In the functional classification of joints, a freely movable joint is called as _____.

a) Synarthrosis b) Amphiarthrosis

c) Syndesmosis d) Diarthrosis

Q2) Long Answers (Any 2 out of 3) **[2 × 10 = 20]**

a) Explain in detail transport mechanisms of substances across the plasma membrane? [CO2]

b) Draw a neat labelled diagram of interior of Heart and explain in detail Cardiac cycle? [CO1]

c) Explain the Functions of Blood and explain in detail the Mechanism of Blood clotting? [CO2]

Q3) Short Answers (Any 7 out of 9) **[7 × 5 = 35]**

a) Explain the levels of structural organization of Human body. [CO1]

b) Explain with example Negative feedback mechanism. [CO2]

c) Explain the Conduction system of Heart. [CO4]

d) Explain the Anatomy and functions of Spleen. [CO1]

e) Explain the ABO system of Blood. [CO3]

f) Write a note on Epithelial tissue. [CO3]

g) Describe the physiology of muscle contraction. [CO1]

h) Explain various stages of cell division. [CO1]

i) Explain the anatomy and physiology of the ear. [CO1]

▽▽▽▽

Total No. of Questions : 3]

SEAT No. :

P3396

[Total No. of Pages : 2

[5552] - 2001
First Year B.Pharmacy (Semester - I)
HUMAN ANATOMY AND PHYSIOLOGY - I
THEORY
(2018 Pattern)

Time : 3 Hours] *[Max. Marks : 75*

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat labeled diagrams must be drawn wherever necessary.***
3) ***Black figures to the right indicate full marks.***

Q1) Answer all the questions (Objectives) (Two mark each) **[2 × 10 = 20]**

a) Draw a neat labeled diagram of Human Eye. [CO1]

b) Explain the functions of Blood. [CO2]

c) Define Homeostasis. Enlist the components of Feedback mechanism. [CO2]

d) Define cell, tissue, organ and system. [CO1]

e) Enlist the different types of WBC's. [CO4]

f) Draw a neat labeled diagram of ECG. [CO1]

g) Explain the functions of Lymphatic system. [CO2]

h) Give the functions of skeletal system. [CO1]

i) Explain Osmosis. [CO3]

j) Enlist the clotting factors. [CO3]

Q2) Long Answers (Any 2 out of 3) **[2 × 10 = 20]**

a) Define Blood pressure. Discuss the factors affecting blood pressure. Explain in detail hormonal regulation of blood pressure. [CO4]

b) Define Joint. Give structural and functional classification of joints. Write a detailed note on Synovial joint. [CO3]

c) Enlist the basic types of tissues with their characteristics. Describe the structure, location and function of various types of connective tissue. [CO1]

P.T.O.

Q3) Short Answers (Any 7 out of 9) **[7 × 5 = 35]**

a) Explain the origin and functions of the cranial nerves. [CO1]

b) Explain with example Positive feedback mechanism. [CO1]

c) Distinguish between Sympathetic and Parasympathetic nervous system. [CO1]

d) Explain the Structure and functions of Lymph node. [CO1]

e) Explain the ABO system of Blood.. [CO1]

f) Describe in detail about Connective tissue. [CO1]

g) Explain the forms of intracellular signaling. [CO1]

h) Explain the structure and working of Neuromuscular junction. [CO1]

i) Explain the anatomy and physiology of the Eye. [CO1]

ⓘⓘⓘ

Subject II
PHARMACEUTICAL ANALYSIS-I
(BP102T)

SCHEME

BP102T Pharmaceutical Analysis -I

SCHEME FOR TEACHING

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP102T	PA-I	03	-	01	04
BP108P	PA-I	-	04	-	02

Schemes for internal assessments and end semester examinations

Course Code	Course Name	Internal Assessment				End Semester Exams		Total Marks
			Sessional Exams					
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP102T	PA-I	10	15	1 Hrs	25	75	3 Hrs	100
BP108P	PA-I	5	10	4 Hrs	15	35	4 Hrs	50

SYLLABUS

BP102T Pharmaceutical Analysis

Sr. No	Topic	Hrs
1	**UNIT-I** **(a) Pharmaceutical analysis-** Definition and scope i) Different techniques of analysis **ii)** Methods of expressing concentration **iii)** Primary and secondary standards. **iv)** Preparation and standardization of various molar and normal solutionsOxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate **(b) Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures	10 Hours
2	**UNIT-II** **Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves. **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	10 Hours
3.	**UNIT-III** **Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration:** Classification, metal ion indicators, maskingand demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry:** Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.	10 Hours
4.	**UNIT-IV** **Redox titrations** (a) Concepts of oxidation and reduction	08 Hours

	(b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry,Titration with potassium iodate	
5	**UNIT-V** **Electrochemical methods of analysis** **Conductometry-** Introduction, Conductivity cell, Conductometric titrations, applications. **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end pointt of potentiometric titration and applications. **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications	07 Hours

Recommended Books: (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London

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

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry

4. Bentley and Driver's Textbook of Pharmaceutical Chemistry

5. John H. Kennedy, Analytical chemistry principles

6. Indian Pharmacopoeia.

LESSION PLAN

BP102T Pharmaceutical Analysis (Theory)

Name of the Faculty: Mrs. Kaveri T. Vaditake

Bloom Levels (BL): L1. Remember L2. Understand L3. Apply L4. Create					
Sr. No	**Description**	**Teaching technology**	**Course outcomes**	**Program outcomes**	**References**
1	**PHARMACEUTICAL ANALYSIS**: Definition and scope	Chalk and talk	**1**	**1**	Kasture Wadodkar
2	Different techniques of analysis	Chalk and talk	**1**	**1**	
3	Methods of expressing concentration,	Chalk and talk	**3**	**3**	
4	Expression of concentration and strength of solution	Chalk and talk	**2**	**2**	
5	Primary and secondary standards	Chalk and talk	**2**	**1**	
6	Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid	Chalk and talk	**3**	**4**	
7	hydrochloric acid, sodium thiosulphate, sulphuric acid,	Chalk and talk	**3**	**4**	
8	potassium permanganate and ceric ammonium sulphate	Chalk and talk	**3**	**4**	
9	**Errors**: Sources of errors,	Chalk and talk	**1**	**2**	Pharmaceutical analysis By ashutosh kar
10	Types of errors,	Chalk and talk	**1**	**2**	
11	Methods of minimizing errors, accuracy, precision and significant figures	Chalk and talk	**2**	**2**	
12	Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves	Chalk and talk	**2**	**1**	
13	Classification of acid base titrations and theory involved in titrations of	Chalk and talk	**2**	**1**	

	strong.				
14	Classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases.	Chalk and talk	**2**	**1**	
15	Classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases	Chalk and talk	**2**	**1**	
16	Classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases	Chalk and talk	**2**	**1**	
17	Neutralization curves.	Chalk and talk	**2**	**1**	
18	**Non Aqueous Acid Base Titration** : Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	Chalk and talk	**2**	**3**	
19	acidimetry and alkalimetry titration	Chalk and talk	**2**	**1**	
20	estimation of Sodium benzoate and Ephedrine HCl	Chalk and talk	**3**	**4**	
21	estimation of Sodium benzoate and Ephedrine HCl	Chalk and talk	**3**	**4**	
22	**Precipitation Reaction And Titration:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride	Chalk and talk	**3**	**3**	Kasture wadodkar
23	Modified Volhard's,.	Chalk and talk			
24	**Complex metric Reaction And Titration:** Classification,	Chalk and talk	**1**	**1**	Kasture wadodkar
25	Metal indicators, Types of complexometric titration.	Chalk and talk	**2**	**2**	
26	estimation of Magnesium sulphate, and calcium gluconate	Chalk and talk	**3**	**4**	
27	masking and demasking	Chalk and	**2**	**3**	

	reagents,.	talk			
28	**Oxidation –Reduction Reaction And Titration:**	Chalk and talk	**1**	**1**	A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry
29	Reactions, Nernst equation, Redox equivalent weights, redox indicators.	Chalk and talk	**1**	**1**	
30	Redox indicators Reactions, Nernst equation.	Chalk and talk	**1**	**2**	
31	Titration with potassium permanganate ceriometry, potassium dichromate.	Chalk and talk	**3**	**4**	
32	Titration with potassium permanganate ceriometry, potassium dichromate.	Chalk and talk	**3**	**4**	
33	Iodine, periodic acid.	Chalk and talk	**3**	**4**	
34	Potassium bromated Titration.	Chalk and talk	**3**	**4**	
35	**Gravimetric Method** : Principles, formation and properties of precipitates.	Power point presentation	**1**	**1**	A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry
36	Unit operations in gravimetry.	Power pointt presentaion			
37	Organic precipitants	Power pointt presentaion	**2**	**1**	
38	**Electrochemical methods of analysis Conductometry-** Introduction, Conductivity cell,	Chalk and talk	**1**	**1**	Instrumental analysis by chatwal anand
39	Conductometric titrations, applications.	Chalk and talk	**3**	**4**	
40	**Potentiometry** - Electrochemical cell, construction and working of reference indicator electrodes (metal electrodes and glass electrode),	Power point presentaion	**1**	**1**	Instrumental analysis by chatwal anand
41	(Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode),	Power pointt presentation	**3**	**1**	

42	methods to determine end pointt of potentiometric titration and applications	Power pointt presentation	**3**	**4**	
43	**Polarography** - Principle, Ilkovic equation,	Power pointt presentation	**2**	**1**	Instrumental analysis by chatwal anand
44	construction and working of dropping mercury electrode and rotating platinum electrode,	Power point presentation	**2**	**2**	
45	Applications	Chalk and talk	**3**	**5**	

COURSE DELIVERY, OBJECTIVES, OUTCOMES

BP102T Pharmaceutical Analysis (Theory)

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon completion of the course student shall be able to

1. Understand the principles of volumetric and electro chemical analysis.
2. Carryout various volumetric and electrochemical titrations.
3. Develop analytical skills.

Course Outcomes (COs):

After successful completion of course student will able to

Upon the completion students are able to **CO-PO**

CO1	To understand **[L1: Knowledge]** principles of various volumetric and electro chemical analysis **[L4: Analysis]** of APIs and formulations.
CO2	To understand Theoretical **[L1: Knowledge]** and practical **[L3: Application]** skills of volumetric methods and electro analytical method.
CO3	Discuss the volumetric analytical methods and **[L2: comprehension]** and various limit test [**L3: Application]** methods as per I.P guidelines.

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
CO1	3	2	2	3	3	-	-	-	-	-	-	3	2	3	3
CO2	3	2	2	3	3	-	-	-	-	-	-	2	1	1	-
CO3	3	2	3	2	3	-	-	-	-	-	-	1	2	2	1
Average	3	2	2	3	3	-	-	-	-	-	-	2	1	2	1

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because it demonstrate the technical knowledge of analytical technique
CO1 with PO2	CO1 is aligned with PO2 because it deals with practical analysis
CO1 with PO3	CO1 is aligned with PO3 because it deals with the design of analytical methods for method development
CO1 with PO4	CO1 is aligned with PO4 because it deals with research based knowledge
CO1 with PO5	CO1 is aligned with PO5 because it deals with the improvement of skills of individuals for handling the analytical tools
CO2 with PO1	CO2 is aligned with PO1 because it moderately deals with the basic knowledge
CO2 with PO2	CO2 is aligned with PO2 because it moderately deals with the analysis
CO2 with PO3	CO2 is aligned with PO3 because analysis of simple process to meet desired need is useful for the design of new analytical techniques
CO2 with PO4	CO2 is aligned with PO4 because through the analysis one can interpret the data and identify the purity of the substances
CO2 with PO5	CO2 is aligned with PO5 because modern analytical tools can be used to improve practical skill in pharmacy practices.
CO3 with PO1	CO3 is aligned with PO1 because for method development the knowledge of volumetric analysis needed in pharmaceutical sciences
CO3 with PO2	CO3 is aligned with PO2 because assays are depends on various parameter and it deals with the formulation of stable product.
CO3 with PO3	CO3 is aligned with PO2 because for any design of any new process system needs to study the validation parameter of the drugs and formulation.
CO3 with PO4	CO3 is aligned with PO4 because it deals with the design of new process for new formulation of drug
CO3 with PO5	CO3 is aligned with PO5 because it deals with the modern tools used for process validation
Justification of CO-PSO Mapping	
CO1 with PSO1	CO1 is aligned with PSO1 because it deals with the technical knowledge of subject
CO1 with PSO2	CO1 is aligned with PSO2 because it deals with understanding of the theoretical concept of the techniques and procedures used for analysis
CO1 with PSO3	CO1 is aligned with PSO3 because it defines the method used for the analysis of finished product and also defines the process used for analysis.
CO1 with PSO4	CO1 is aligned with PSO4 because it deals with the knowledge of technique one can define the process to meet desired need.
CO2 with PSO1	CO2 is aligned with PSO1because it deal with the theoretical knowledge and practical skill of the analytical instruments.
CO2 with	CO2 is aligned with PSO2 because it deals with understanding of the

PSO2	theoretical concept and practical skills.
CO2 with PSO3	CO2 is aligned with PSO3 because it defines the analysis of process and finished product in limits.
CO2 with PSO4	CO2 is aligned with PSO3 because it deals with the defining the procedure for the analysis which meet the desired standard of safety for humans.
CO3 with PSO1	CO3 is aligned with PSO1 because it deals with the development of technical knowledge of practical skill of analytical techniques.
CO3 with PSO2	CO3 is aligned with PSO2 because it deals with the development of new assay process and procedure for manufacturing new drug.
CO3 with PSO3	CO3 is aligned with PSO3 because it deals with the evaluation of drugs and finished products as per I.P.
CO3 with PSO4	CO3 is aligned with PSO4 because it deals with the designing assay for stable formulation.

QUESTION BANK

BP102T Pharmaceutical Analysis

Bloom Levels (BL): L1. Remember L2. Understand L3. Apply L4. Create			
Sr.No	**Topics**	**Co mapped**	**Bloom level**
UNIT-I			
1	Define a scope of analytical chemistry	**CO1**	**1**
2	Difference between qualitative analysis and quantitative analysis.	**CO1**	**2**
3	Write brief about molecular weight and equivalent weight.	**CO1**	**1**
4	Define equivalent weight, normality, molarity molality.	**CO1**	**1**
5	Define the term primary standard and give examples of primary standards used in acid base titration.	**CO1**	**2**
6	Give properties of primary standard.	**CO1**	**2**
7	Explain in brief about primary standards.	**CO1**	**2**
8	Differentiate between primary standard and secondary standard.	**CO1**	**2**
9	Explain various methods of qualitative and quantitative analysis.	**CO1**	**3**
10	Write about fraction of mole and how to determine it?	**CO1**	**1**
11	Write preparation of molar and normal solution and its standardization of ➢ ***Oxalic acid, Sodium hydroxide,*** ➢ ***Hydrochloric acid, Sodium thiosulphate,*** ➢ ***Sulphuric acid, Potassium permanganate and*** ➢ ***Ceric ammonium sulphate***	**CO2**	**3**
12	Write about the principle .reaction and procedure for limit test limit test of (with well labled diagram ➢ ***Arsenic Sulphate*** ➢ ***Iron Chloride***	**CO1/CO2**	**3**
13	Write a note on history of I.P	**CO1**	**1**
14	Write a note on sources of impurity	**CO1**	**2**
Errors			
15	Define an error and Write a note on Sources of	**CO1**	**1**

	errors.		
16	Explain in detail different types of errors.	**CO1**	**2**
17	Explain different methods of minimizing errors.	**CO2**	**3**
18	Define following terms write in brief about ***Accuracy, Precision and Significant figures***	**CO1**	**1**
	UNIT –II		
	ACID BASE TITRATION		
19	What is buffer index? Explain different types of buffer in detail.	**CO1**	**1**
20	Explain buffer indetail.What is buffer index? Derive an equation to calculate buffer solution.	**CO1**	**2**
21	Explain in detail Neutralization curve.	**CO1**	**2**
22	Write a note on handerson haselbalch equation.	**CO1**	**1**
23	Explain roll of acid base indicator in detail.	**CO1/CO2**	**2**
24	Explain following theories of acid base Indicators ***Resonance theory Ostwald theory***	**CO1**	**2**
25	Classify Acid Base titration. Explain weak acid and base titration.	**CO2**	**3**
26	Give neutralization curve of weak acid weak base with example.	**CO2**	**3**
27	Explain what polyproticacid.Explain in brief polyfunctional titration is.	**CO1**	**2**
28	Classify chemical indicators with suitable examples.	**CO1**	**2**
29	Explain different theories involved in acid base titration.	**CO1**	**2**
30	Explain titration of amino acids.	**CO1**	**3**
31	Describe distribution of acid and bases with PH.	**CO1**	**2**
32	Enlist the different indicators used in acid base titration.	**CO1**	**1**
	NON AQUEOUS ACID BASE TITRATION.		
33	Write a note dissociating and non-dissociating solvents in detail	**CO2**	**1**
34	What are amphiprotic solvents?	**CO1**	**1**
35	Discuss about different solvent used in non aqueous titration.	**CO2**	**1**
36	Explain leveling and differentiating effect.	**CO1**	**1**
37	Application of non-aqueous titration.	**CO3**	**3**
38	Write in detail about preparation and standardization 0.1 N perchloric acid.	**CO1/ CO2**	**3**
39	Give limitation advantages indicators used in non-	**CO1**	**2**

	Aqueous titration.		
40	Give effect of temperature on non-aqueous titration.	**CO3**	**3**
41	Write estimation of Benzoate and ephedrine (Assay with standardization of perchloric acid,Principle ,reaction)	**CO2/CO3**	**3**
42	Write a note on organic and inorganic solvents.	**CO1**	**2**
43	Explain Acidimetry and alkalimetry titration.	**CO1**	**2**
UNIT-III			
PRECIPITATION TITRATION			
44	Explain Mojrs method along with example. (Assay of Nacl –Preperation and stabdardization of AgNo3, Reaction of standardization , Principle reaction of assay ,indicator used)	**CO2**	**3**
45	Explain Volhard Method alomg with example.	**CO2**	**3**
46	Explain in detail modified Volhard method.	**CO2**	**3**
47	Explain Fajan's method With figure.	**CO2**	**2**
48	Write a note about factors affecting the solubilty**.**	**CO1**	**2**
49	Write a note about factor affecting the chemical reaction in solution.	**CO1**	**2**
50	Explain common ion effect. How it is utilized for controlling concentration of weak acid electrolytes.	**CO1**	**1**
51	Explain preparation and standardization of 0.1 n AgNO3 solutions.	**CO2**	**3**
52	Expailn principle involved in precipitation titration.	**CO1**	**2**
53	Write a note on indicators used in precipitation titration.	**CO1**	**2**
54	Write difference between mohrs method volhard method and Fajans method.	**CO2**	**2**
55	What is adsorption indicator explain in detail	**CO1**	**2**
56	Write a limitations of fajans method.	**CO1**	**1**
57	Explain application of precipitaion titration.	**CO3**	**1**
3.2 COMPLEXOMETRIC TITRATION			
58	Explain ligand and sequestering agent write detail types of ligands with examples.	**CO1**	**2**
59	Define chelating agents	**CO1**	**1**
60	What are the complexes and chelates. Explain stability of complex and factor influencing it.	**CO1**	**1**
61	Explain different type's complex metric titration with examples, principle and reaction.	**CO1**	**2**
62	Write preparation and standardization of 0.05 M	**CO2**	**3**

	Disodium EDTA with principle and reaction.		
63	What is the masking and damasking agents write its examples of metal with its masking and damasking agents.	**CO2**	**1**
64	Why metal EDTA most commonly used as complexing agent.	**CO1**	**2**
65	Explain in detail metalo chromic indicators (metal indicator).Write its characteristics and properties.	**CO1**	**2**
GRAVIMETRIC ANALYSIS.			
66	What is principle and steps involved in gravimetric analysis?	**CO1**	**1**
67	Explain different types of gravimetric analysis (classification).	**CO1**	**1**
68	Give the properties of precipitation.	**CO1**	**2**
69	Explain mechanism of precipitate formation.	**CO1**	**2**
70	Explain types of precipitate.	**CO1**	**1**
71	Write a note on CO-Precipitation and post precipitation	**CO2**	**2**
72	Give advantages and disadvantages of gravimetric analysis.	**CO1**	**1**
73	co-precipitation? How it is reduced**?**..	**CO2**	**2**
74	Explain in brief method of minimization of post precipitate.	**CO2**	**3**
75	Write a note application of gravimetric titration.	**CO3**	**3**
76	Differentiate between co-precipitates and post precipitate.	**CO1**	**2**
77	Explain and list organic and inorganic precipitant.	**CO1/CO2**	**1**
78	What is procedure for estimation **of Barium sulphate.**	**CO2**	**3**
UNIT IV			
4.1 OXIDATION REDUCTION TITRATION.			
79	Define Reduction and Oxidation with example.	**CO1**	**1**
80	What is redox potential.Give mathematical expression for nurst equation?	**CO1**	**1**
81	Give method of calculation of equivalent weight.	**CO2**	**2**
82	Explain redox Indicator	**CO2**	**2**
83	Write a note on ***Self indicator and starch indicator***	**CO2**	**2**
84	How redox indicator change its color near the end point.	**CO1/CO2**	**2**
85	Explain different types of redox titration	**CO1**	**1**
86	Explain titanus chloride.	**CO1**	**2**

87	Give the method of preperation and standardization of 0.02M and 0.1 M KMnO4 solution.	**CO2**	**3**
88	Write a note on redox titration.	**CO1**	**1**
89	Explain redox curve in detail.	**CO2**	**2**
90	Discuss ceriometric titration.	**CO1/ CO2**	**2**
91	Explain iodometric and iodimetric titration. Write difference between it.	**CO1/ CO2**	**1**
92	Why starch indicator add near to end point.	**CO2/3**	**3**
93	Enlist different conditions used in iodometric titration.	**CO1**	**2**
94	Explain principle of redox titration.	**CO1**	**1**
95	Explain principle, preperation and standardization of 0.05 M Iodine solution.	**CO2**	**1**
96	Write pharmaceutical Application of redox titration.	**CO3**	**3**
97	Write the preparation of 0.1 M ceric ammonium sulphate.	**CO2**	**3**
98	Explain in brief periodic acid.	**CO1**	**1**
99	Write the different types of permanganate titration.	**CO1**	**1**
100	What is half reaction and how it is balanced.	**CO1**	**1**
101	Explain bromated titration.	**CO2**	**3**
102	Application of redox titration.	**CO3**	**3**
103	WHY KMNO4 Act as self indicator.	**CO2**	**2**
UNIT-V **Electro chemical analysis**			
5.1 CONDUCTOMETRY			
104	Explain principle of conductometry.	**CO1**	**2**
105	Explain following terms ➢ ***Conductance*** ➢ ***Specific conductance*** ➢ ***Specific resistance*** ➢ ***Equivalent conductance*** ➢ ***Molecular Conductance***	**CO1**	**1**
106	What is factors affecting conductance.	**CO2**	**1**
107	Write a note on conductivity cell	**CO1**	**1**
108	What is cell constant?	**CO1**	**1**
109	Explain methods of conductance measurement.	**CO2**	**3**
5.2POTENTIOMETRY			
110	Write the principle of potentiometry.	**CO1**	**2**
111	Explain about Electrochemical cell	**CO1**	**2**

112	Explain Construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode)	**CO2**	**2**
113	Write in detail indicator electrodes (metal electrodes and glass electrode)	**CO1**	**1**
114	Explain methods to determine end point of potentiometric titration	**CO2**	**3**
115	Write application of applications.	**CO3**	**3**

MODEL ANSWERS

BP102T Pharmaceutical Analysis

1. Explain Different analytical concentrations.

Answer:

Normality is a measure of concentration that is equal to the gram equivalent weight per liter of solution. Gram equivalent weight is a measure of the reactive capacity of a molecule. The solution's role in the reaction determines the solution's normality.

Normality = number of mole equivalents/1 L of solution.

For acid reactions, a 1 M H_2SO_4 solution will have normality (N) of 2 N
because 2 moles of H+ ions are present per liter of solution.
For sulfide precipitation reactions, where the SO_4^- ion is the most significant factor, the same 1 M H_2SO_4 solution will have normality of 1 N.

Molarity is the most commonly used measure of concentration. It is expressed as the number of moles of solute per liter of solution.
For example, a 1 M solution of H_2SO_4 contains 1 mole of H_2SO_4 per liter of solution.
H_2SO_4 dissociates into H^+ and SO_4^- ions in water. For every mole of H_2SO_4 that dissociates in solution, 2 moles of H^+ and 1 mole of SO_4^- ions are formed. This is where normality is generally used.

2. What are primary standards and secondary standards?

Answer:

Primary standards

Primary standards are typically used in titration to determine an unknown concentration and in other analytical chemistry techniques. Titration is a process in which small amounts of a reagent are added to a solution until a chemical reaction occurs. The reaction provides confirmation that the solution is at a specific concentration. Primary standards are often used to make standard solutions (a solution with a precisely known concentration).
A good primary standard meets the following criteria:

- high level of purity
- low reactivity (high stability)
- high equivalent weight (to reduce error from mass measurements)
- not likely to absorb moisture from the air (hygroscopic) to reduce changes in mass in humid versus dry environments
- non-toxic
- inexpensive and readily available

There are many examples of primary standards; a few of the most common include:

- Sodium chloride (NaCl) is used as a primary standard for silver nitrate ($AgNO_3$) reactions.
- Zinc powder may be used to standardize EDTA solutions after it has been dissolved in hydrochloric acid or sulfuric acid.
- Potassium hydrogen phthalate or KHP may be used to standardize perchloric acid and an aqueous base in an acetic acid solution.

Secondary Standard

A related term is "secondary standard". A secondary standard is a chemical that has been standardized against a primary standard for use in a specific analysis. Secondary standards are commonly used to calibrate analytical methods. NaOH, once its concentration has been validated through the use of a primary standard, is often used as a secondary standard.

3. What is error? Explain types of errors.

Answer:

Determinate (Systematic) Errors

These are errors that possess a definite value together with a reasonable assignable cause however, in principle these avoidable errors may be measured and accounted for conveniently. The most important errors belonging to this particular class are:

Personal Errors: They are exclusively caused due to 'personal equation' of an analyst and have no bearing whatsoever either on the prescribed procedure or methodology involved.

Instrumental Errors: These are invariably caused due to faulty and uncalibrated instruments, such as : pH meters, single pan electric balances, uv-spectrophotometers, potentiometers etc.

These two errors have been duly discussed under the chapter on 'Pharmaceutical Chemicals: Purity and Management'.

Reagent Errors: The errors that are solely introduced by virtue of the individual reagents, for instance: impurities inherently present in reagents; high temperature volatilization of platinum (Pt); unwanted introduction of 'foreign substances' caused by the action of reagents on either porcelain or glass apparatus.

Constant Errors: They are observed to be rather independent of the magnitude of the measured amount; and turn out to be relatively less significant as the magnitude enhances.

Example : Assuming a constant equivalence—point error of 0.10 ml is introduced in a series of titrations, hence for a specific titration needing only 10.0 ml of titrant shall represent a relative error of 1% and only 0.2% for a corresponding 50 ml of titrant consumed.

Proportional Errors: The absolute value of this kind of error changes with the size of the sample in such a fashion that the relative error remains constant. It is usually incorporated by a material that directly interferes in an analytical procedure.

Example: Estimation of 'chlorate'—an oxidant by iodometric determination. In this particular instance *two* things may happen, namely:

Presence of 'Bromate'—another oxidizing agent would give rise to positively higher results, and hence, it must be duly corrected for, and

Absolute error might increase while dealing with large samples, whereas the relative error would remain more or less constant if the sample is perfectly homogenous,

Errors due to Methodology: Both improper (incorrect) sampling and incompleteness of a reaction often lead to serious errors. A few typical examples invariably encountered in titrimetric and gravimetric analysis are cited below

Additive Errors: It has been observed that the additive errors are independent of the quantum of the substances actually present in the assay.

Examples: (*i*) Errors caused due to weights, and (*ii*) Loss in weight of a crucible in which a precipitate is incenerated. Detection of this error is ascertained by taking samples of different weights.

Indeterminate (Random) Errors

As the name suggests, indeterminate errors cannot be pin-poi d to any specific well-defined reasons. They are usually manifested due to the minute variations which take place inadvertently in several successive measurements performed by the same analyst, using utmost care, under almost identical experimental parameters. These errors are mostly random in nature and ultimately give rise to high as well as low results with equal probability. They can neither be corrected nor eliminated, and therefore, form the **'ultimate limitation'** on the specific measurements. It has been observed that by performing repeated measurement of the same variable, the subsequent statistical treatment of the results would have a positive impact of **'reducing their importance'** to a considerable exten

Salient Features of Indeterminate Errors

The various salient features of indeterminate errors are enumerated below :

Repeated measurement of the same variable several times and subsequent refinement to the extent where it is simply a coincidence if the corresponding replicates eventually agree to the last digit,Both unpredictable and imperceptible factors are unavoidably incorporated in the results what generally appear to be '*random fluctuations*' in the measured quantity,

Recognition of specific definite variables which are beyond anyone's control lying very close to the performance limit of an instrument, such as: temperature variations, noise as well as drift from an electronic circuit, and vibrations caused to a building by heavy vehicular-traffic,

A variation that may be regarded as random by a slipshod analyst may at the same time prove to be quite evident and manageable by a careful observer, and

The average of a number of fine observations having random scatter is definitely more accurate, precise and, hence, more cogent than coarse data that appear to agree perfectly

4. Explain different neutralization curve in Acid-Base Titration.

Answer:

An acid base titration, a known quantity of acid is used to estimate an unknown amount of a base or vice-versa. A known reactant is taken in a burette and the test in a beaker. The reactant from burette is added drop by drop while the beaker is swirled to enhance the reaction. This is continued until the endpoint is reached.

An acid-base indicator is used to indicate the end point of reaction. These indicators change the color of the solution at the endpoint. In modern labs instead of indicators, pH meters are used to detect the endpoint.

Types of Acid Base Titration

Acid base titration can be done in both aqueous and non-aqueous media.

A. Aqueous acid base titration

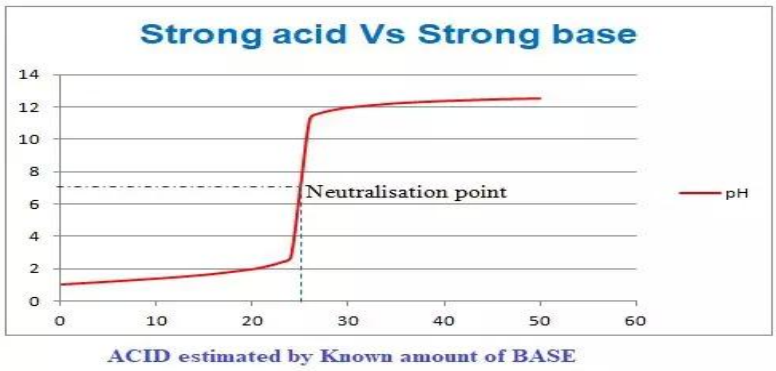
These are normal titration between acids and base dissolved in water. Hence the name aqueous titration. They are prominently used in academic labs and for standardization.

1) Strong acid V/s strong base

Here are strong acid reacts with a strong alkali to form salt and water. The reaction of this type is swift and also complete. The reaction happens in stoichiometric means, i.e., each molecule of acid reacts with the corresponding molecule of the base. At the end of the reaction, no molecule of acid or base exists as every molecule in the reaction has completely reacted to form a salt. Hence the endpoint or equivalence point is precise and sharp.

Examples of these types of acids are HCl, H2So4, HNO3, HBr, HClO4 (perchloric acid), H3PO4, etc. The examples of strong bases are NaOH, MgOH2, Al2OH3, etc.

Reaction example: HCl+NaOH————————-> NaCl + H2O



The pH at the end point is neutral, i.e., 7. So indicators changing their color around pH seven are used here.

2) Strong Acid v/s Weak Base

Here a strong base reacts with a weak acid to form salt and water. But since the reaction uses a strong acid, the pH at the endpoint will be towards acidic, i.e., below 7.Here the salt formed NH4Cl is slightly acidic. So indicators changing color at lower pH's are employed. During the reaction, a known concentration of strong acid is taken in a burette and allowed to react drop by drop with the base in a beaker.

Reaction example: HCl+NH4OH————————>NH4Cl + H2O.

3) Weak Acid V/s Strong Base

Here the reaction happens between a weak acid and strong base. The weak acid is taken in a beaker and known quantity of strong base is dropped from a burette till the endpoint.

Reaction example: H2CO3+ NaOH————>Na2Co3+H2O

The salt formed is slightly basic, so the pH at the end point is above 7. The indicator used is one with a change in color at higher pHs.

4) Weak Acid V/s Weak Base

Here both acid and base are weak. So mostly they are avoided due to imprecise endpoints. At the endpoint, the pH will be seven theoretically. But cannot be measured precisely like that in strong acid and strong base case. An extra amount of titrant is needed to reach the endpoint due to the imprecise reaction.

Reaction example: H2CO3+NH4OH————>NH4OH+H2O

The endpoint is neutral as the salt is neutral, but due t excess titrant added the pH could be in favor of it.

5. Write the preparation ad standardization of sodium hydroxide ad sulphuric acid, hydrochloric acid?

Answer:

1. N Sodium hydroxide:

Equivalent weight of NaOH is ~ 40.0 g

i.e. sum of atomic weight - (Na — 23g) + (Oxygen — 16g) + (Hydrogen — 1g)

1 N NaOH solution

Dissolve 40.0g of NaOH in 1 litre of water.

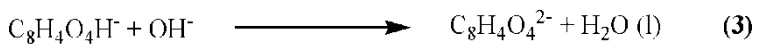
0.1 N NaOH Solution

Dissolve 4.0 g of NaOH in 1 litre of Water.

Standardization of NaOH with KHP.

Weigh ~0.8 g of dried KHP (MW = 204.23 g/mol) into an Erlenmeyer flask and dissolve in 50-75 mL of distilled water.Record the amount of KHP and water used.

Add 4 drops of indicator into the flask and titrate to the first permanent appearance of pink. Near the endpoint, add the NaOH dropwise to determine the total volume most accurately.



Preparation of HCL

Transfer 85 ml HCL in 500 ml distilled water and make up the volume up to 1000 ml.

Standardizing an HCl Solution

1. Weigh 0.2 g Na_2CO_3 into an Erlenmeyer flask and dissolve it in 50 mL of boiled, cooled distilled water. Record the exact amount of Na_2CO_3 used in your notebook. (The water is boiled to expel CO_2 from the solution.)
2. Add 4 drops of phenolphthalein to the solution and record the color.
3. Titrate with the HCl until just before the endpoint (when the solution is very light pink) and then gently boil the solution to expel the CO_2 from solution that has been produced during the reaction.

4. Cool the solution to room temperature and then wash the sides of the flask with a small amount of H_2O to get the entire sample back into solution.
5. Finish the titration (this will take VERY little HCl so go slow!)
6. Record the color of the solution and the volume of HCl used.

$$2\,HCl\,(aq) + Na_2CO_3\,(aq) \longrightarrow NaCl\,(aq) + H_2O\,(l) + CO_2\,(g) \qquad (4)$$

6. Write a note solvents used non-aq titration in detail.

Anwser:

Non Aqueous Titration Theory

The need for non aqueous titration arises because water can behave as a weak base and a weak acid as well, and can hence compete in proton acceptance or proton donation with other weak acids and bases dissolved in it.

The procedure of non aqueous titration is very useful because it satisfies two different requirements, namely – suitable titration of very weak acids or bases along with providing a solvent with an ability to dissolve organic compounds.

An example of a reaction in which water is not a suitable solvent is the reaction given by:

$$R\text{-}NH_2 + H^+ \rightleftharpoons R\text{-}NH_3^+$$

which is competed with in an aqueous solvent by the reaction given by:

$$H_2O + H^+ \rightleftharpoons H_3O^+$$

This type of competition provided by water towards weak bases or weak acids makes it difficult to detect the end point of the titration. Therefore, these substances which have very sharp end points when titrated in aqueous solutions due to their weakly basic or weakly acidic nature generally need to be titrated in non aqueous solvents.

Many reactions which occur in non aqueous titration procedures can be explained via the Bronsted-Lowry Theory and its definition of acids and bases. Basically, acids can be thought of as proton donors, whereas bases can be thought of as proton acceptors.

It can also be noted that potentially acidic substances can behave as acids only when a base (to which a proton can be donated) is present. The converse of this statement also holds true, i.e. potentially basic substances can behave as bases only when an acid (from which a proton can be accepted) is present.

Types of Non Aqueous Solvents

Typically, there exist four types of solvents used in the non aqueous titration of a given analyte. These are:

- **Aprotic Solvents –** these solvents are neutral in charge and are chemically inert. They also generally have a low dielectric constant. Examples of these types of solvents include chloroform and benzene.
- **Protophilic Solvents –** these solvents have a basic character and tend to react with the acids they come in contact with, leading to the formation of solvated protons. Examples of protophilic solvents are ammonia and pyridine.
- **Protogenic Solvents –** these solvents have a more acidic character and tend to have a leveling effect on the bases they come in contact with. Examples of protogenic solvents used in non aqueous titration are sulfuric acid and acetic acid.

- **Amphiprotic Solvents –** these solvents have properties which are protophilic as well as protogenic. Examples of these types of solvents are acetic acid and alcohols.

7. Write in detail about preparation and standardization 0.1 N perchloric acid.

Answer:

Take about 500 ml of anhydrous glacial acetic acid and about 25 ml acetic anhydride in a cleaned and dried 1000 ml volumetric flask. Add about 8.5 ml of Perchloric acid (About 70%) with continues stirring. Cool the solution. Make up the volume 1000ml with anhydrous glacial acid. Mix solution thoroughly. Keep the solution for at least 24 hours for the excess acetic anhydride to be combined. Then carry out the determination of water. If the water content exceeds 0.05% add more acetic anhydride. If the solution contains water, add sufficient water to obtain a content of water between 0.02% to 0.05%. Allow the solution to stand for 1 day and again titrate the water content. The solution so obtained should contain between 0.02% and 0.05% of water. Standardize the solution.

Standardization of perchloric acid

Weigh accurately about dissolve 0.35 g of potassium hydrogen phthalate in 50 ml of anhydrous acetic acid, warming gently if necessary. Allow to cool protected from the air and titrate with the perchloric acid solution using 0.05 ml of crystal violet solution as indicator.

Each ml of 0.1M perchloric acid VS is equivalent to 20.42 mg of C8H5KO4.
Perform a duplicate and calculate the molarity factor.(MF)

8. Write estimation of Benzoate.

Answer:

Sodium Benzoate:
Formula: C7H5NaO2
Mol. Wt. 144.1
Sodium Benzoate contains not less than 99.0 per cent and not more than 100.5 per cent of C7H
5NaO2, calculated on the dried basis.

Preparation of 0.1N solution of HClO4 and its standardization:
Dissolve 8.5 ml of 72% HClO4 in about 900 ml glacial acetic acid with constant stirring, add about 30 ml acetic anhydride and make up the volume (1000 ml) with glacial acetic acid and keep the mixture for 24 hour. Acetic anhydride absorbed all the water from HClO4 and glacial acetic acid and renders the solution virtually anhydrous. HClO4 must be well diluted with glacial acetic acid before adding acetic anhydride because reaction between HClO4 and acetic anhydride is explosive.
Standardisation of HClO4:

To 500 mg of potassium acid phthalate add 25 ml of glacial acetic acid and add few drops of 5% w/v crystal violet in glacial acetic acid as indicator. This solution is titrated with 0.1 HClO4. The colour changes from blue to blue green.

Assay Procedure:

Weigh accurately about 0.25 g of Sodium Benzoate, dissolve in 20 ml of anhydrous glacial acetic acid, warming to 50º if necessary, cool. Titrate with 0.1 M perchloric acid, using 0.05 ml of 1-naphtholbenzein solution as indicator. Carry out a blank titration.

Equivalent or I.P factor:

1 ml of 0.1 M perchloric acid is equivalent to 0.01441 g of C7H5NaO2.

9. Write the preparation and standardization of AgNO3.

Answer:

Assay of Nacl

Preparation of standard AgNO3 solution:

9.0 g of AgNO3 was weighed out, transferred to a 500 mL volumetric flask and made up to volume with distilled water. The resulting solution was approximately 0.1 M. This solution was standardized against NaCl. Reagent-grade NaCl was dried overnight and cooled to room temperature. 0.2500 g portions of NaCl were weighed into Erlenmeyer flasks and dissolved in about 100 mL of distilled water. In order to adjust the pH of the solutions, small quantities of NaHCO3 until effervescence ceased. About 2 mL of K2Cr2O7 was added and the solution was titrated to the first permanent appearance of red colour.

Solutions Needed Concentrated nitric acid (see safety notes): (6 mol L-1) Silver nitrate solution: (0.1 mol L−1). If possible, dry 5 g of AgNO3 for 2 hours at 100°C and allow cooling. Accurately weigh about 4.25 g of solid AgNO3 and dissolve it in 250 mL of distilled water in a conical flask. Store the solution in a brown bottle.

Potassium thiocyanate solution: (0.1 mol L−1). Weigh 2.43 g of solid KSCN and dissolve it in 250 mL of distilled water in a volumetric flask.

Potassium permanganate solution: (5%) Add 1.5 g KMnO 4 to 30 mL of distilled water.

Ferric ammonium sulfate solution: (saturated) Add 8g of NH 4 Fe(SO4) 2 .12H2O to 20 mL of distilled water and add a few drops of concentrated nitric acid (see safety notes).

Method

Sample Preparation

The salt sodium chloride is added during the manufacture of cheddar cheese. In this method, the cheese is ‘digested’ to release this salt to obtain the concentration of chloride ions. To carry out this digestion, the cheese is reacted with nitric acid and potassium permanganate. The chloride ions are then ‘free’ to form a precipitate with the added silver ions.

1. Cut or grate the cheese into fine pieces and accurately weigh about 6 g into a 500 mL conical flask.

2. Precisely add 50 mL of 0.1 mol L−1 silver nitrate solution (by pipette if possible), 20 mL of concentrated nitric acid, (very carefully – see safety notes), 100 mL of distilled water and a few boiling chips, and heat the solution to boiling in fumehood.
3. As the solution boils add 5 mL of 5% potassium permanganate solution. This addition will cause a very smelly reaction so done in the fumehood. Keep boiling until the purple colour disappears, then add another 5 mL of potassium permanganate solution.
Continue this process until 30 mL of potassium permanganate solution has been added and the cheese particles are completely digested (or as close as possible).
To find out when digestion is complete, remove the flask from heat and allow it to stand for a few moments.
Undigested cheese particles will float upon the surface of the clear liquid, while the white precipitate of silver chloride will sink to the bottom. If there is still too much undigested cheese, the boiling.

Principle

This method uses a back titration with potassium thiocyanate to determine the concentration of chloride ions in a solution. Before the titration an excess volume of a silver nitrate solution is added to the solution containing chloride ions, forming a precipitate of silver chloride. The][p term ‘excess‘ is used as the moles of silver nitrate added are known to exceed the moles of sodium chloride present in the sample so that all the chloride ions present will react.

$$Ag+ (aq) + Cl– (aq) \rightarrow AgCl(s)$$

The indicator Fe3+ (ferric ion) is then added and the solution is titrated with the potassium thiocyanate solution.
The titrate remains pale yellow as the excess (unreacted) silver ions react with the thiocyanate ions to form a silver thiocyanate precipitate.

$$Ag+ (aq) + SCN– (aq) \rightarrow AgSCN(s)$$

Once all the silver ions have reacted, the slightest excess of thiocyanate reacts with Fe3+ to form a dark red complex.

$$Fe3+ (aq) + SCN– (aq) \rightarrow [FeSCN]2+ (aq)$$

The concentration of chloride ions is determined by subtracting the titration findings of the moles of silver ions that reacted with the thiocyanate from the total moles of silver nitrate added to the solution. This method is used when the pH of the solution, after the sample has been prepared, is acidic. If the pH is neutral or basic, Mohr’s method or the gravimetric method should be used. The method is illustrated below by using the procedure to determine the concentration of chloride (from sodium chloride) in cheese. Equipment Needed boiling chips 500 mL volumetric flask 10 mL and 100 mL measuring cylinders conical flasks Bunsen burner, tripod and gauze burette and stand 50 mL pipette (if possible) Determination of Chloride Ion Concentration by Titration (Volhard’s Method) 1 Determination of Chloride Ion Concentration by Titration (Volhard’s Method). Introduction This method uses a back titration with potassium thiocyanate to determine the concentration of chloride ions in a solution. Before the titration an excess volume of a silver nitrate solution is added to the solution containing chloride ions, forming a precipitate of silver chloride. The term ‘excess‘ is used as the moles of silver nitrate

added are known to exceed the moles of sodium chloride present in the sample so that all the chloride ions present will react.

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$Ag^+ (aq) + SCN^- (aq) \rightarrow AgSCN(s)$

Once all the silver ions have reacted, the slightest excess of thiocyanate reacts with Fe^{3+} to form a dark red complex.

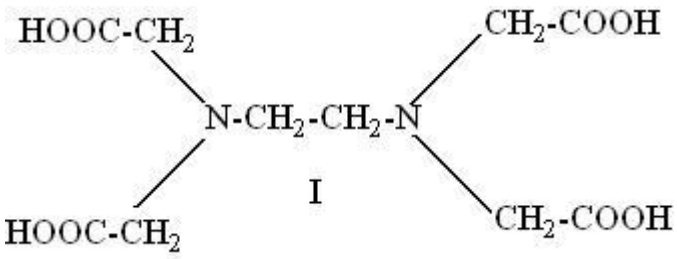
$Fe^{3+} (aq) + SCN^- (aq) \rightarrow [FeSCN]^{2+} (aq)$.

The concentration of chloride ions is determined by subtracting the titration findings of the moles of silver ions that reacted with the thiocyanate from the total moles of silver nitrate added to the solution. This method is used when the pH of the solution after the sample has been prepared is acidic. If the pH is neutral or basic, Mohr's method or the gravimetric method should be used.

10. What is the principle of complexometric titration?

Answer:

Complex metric titrations are particularly useful for determination of a mixture of different metal ions in solution. Ethylene diamine tetra acetic acid (EDTA), is a very important reagent for complex formation titrations. EDTA has been assigned the formula II in preference to I since it has been obtained from measurements of the dissociation constants that two hydrogen atoms are probably held in the form of zwitter ions.



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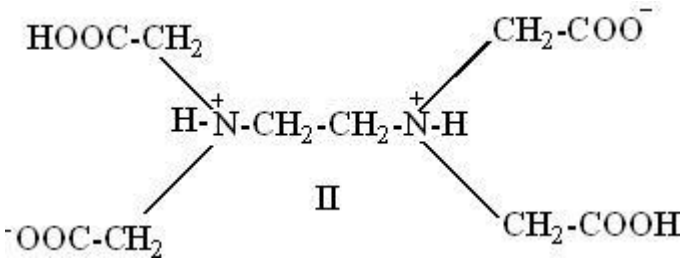


II

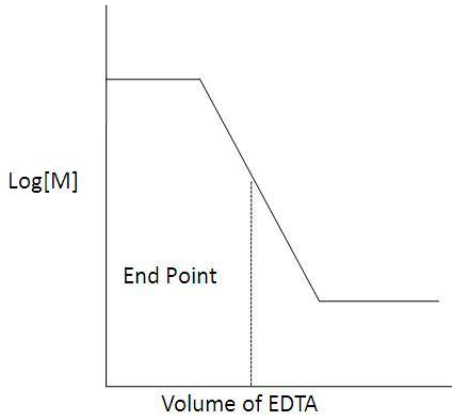
EDTA behaves as a dicarboxylic acid with two strongly acidic groups. For simplicity EDTA may be given the formula H_4Y, the disodium salt is therefore Na_2H_2Y and it has the complex forming ion H_2Y^{2-} in aqueous solution. The reactions with cationsmay be represented as;

$M^{2+} + H_2Y^{2-} \rightarrow MY^{2-} + 2H^+$

$M^{3+} + H_2Y^{2-} \rightarrow MY^{-} + 2H^+$

$M^{4+} + H_2Y^{2-} \rightarrow MY + 2H^+$

One gram ion of the complex-forming ion H_2Y^{2-} reacts in all cases with one gram ion of the metal. EDTA forms complexes with metal ions in basic solutions. In acid-base titrations the end point is detected by a pH sensitive indicator. In the EDTA titration metal ion indicator is used to detect changes of pM. It is the negative logarithm of the free metal ion concentration, i.e., pM = - log $[M^{2+}]$. Metal ion complexes form complexes with specific metal ions. These differ in colour from the free indicator and a sudden colour change occurs at the end point. End point can be detected usually with an indicator or instrumentally by potentiometric or conductometric (electrometric) method.



There are three factors that are important in determining the magnitude of break in titration curve at end point.

- **The stability of complex formed:** The greater the stability constant for complex formed, larger the charge in free metal concentration (pM) at equivalent point and more clear would be the end point.
- **The number of steps involved in complex formation:** Fewer the number of steps required in the formation of the complex, greater would be the break in titration curve at equivalent point and clearer would be the end point.
- **Effect of pH:** During a complexometric titration, the pH must be constant by use of a buffer solution. Control of pH is important since the H^+ ion plays an important role in chelation. Most ligands are basic and bind to H^+ ions throughout a wide range of pH. Some of these H^+ ions are frequently displaced from the ligands (chelating agents) by the metal during chelate formation.
- Equation below shows complexation between metal ion and H^+ ion for ligand:

$$M_2^+ + H_2\text{-EDTA} \rightarrow \text{M-EDTA} + 2H^+$$

Thus, stability of metal complex is pH dependent. Lower the pH of the solution, lesser would be the stability of complex (because more H^+ ions are available to compete with the metal ions for ligand). Only metals that form very stable complexes can be titrated in acidic solution, and metals forming weak complexes can only be effectively titrated in alkaline solution.

11. Explain different types of Complexometric titration.

Answer:

Types of Complexometric Titration:

As mentioned earlier, EDTA is a versatile chelating titrant that has been used in innumerable complexometric determinations. The versatility of EDTA can be ascribed to the different ways in which the complexometric titration can be executed. Let us learn about different ways in which we can use EDTA titrations.

1. **Direct Titration:** It is the simplest and the most convenient method in which the standard solution of EDTA is slowly added to the metal ion solution till the end point is achieved. It is similar to simple acid-base titrations. For this method to be useful the formation constant must be large and the indicator must provide a very distinct colour change as mentioned earlier. Further we need standardized solution of EDTA and sometimes auxiliary complexing agents may be required. Some important elements which could be determined directly by the complexometric titration are Cu, Mn, Ca, Ba, Br, Zn, Cd, Hg, Al, Sn, Pb, Bi, Cr, Mo, Fe, Co, Ni, and Pd, etc. However, the presence of other ions may cause interference and need to be suitably handled.

2. **Back Titration:** In this method, an excess of a standard solution of EDTA is added to the metal solution being determined so as to complex all the metal ions present in the solution. The excess of EDTA left after the complex formation with the metal is back titrated with a standard solution of a second metal ion. This method becomes necessary if the analyte precipitates in the absence of EDTA or reacts too slowly with EDTA, or it blocks the indicator. For example, determination of Mn is done by this method because a direct titration is not possible due to precipitation of $Mn(OH)_2$. The excess EDTA remaining after complexation, is back titrated with a standard Zn solution using Eriochrome black T as indicator. However, one has to ensure the standard metal ion should not displace the analyte ion from their EDTA complex.

3. **Replacement Titration:** When direct or back titrations do not give sharp endpoints or when there is no suitable indicator for the analyte the metal may be determined by this method. The metal to be analyzed is added to a metal-EDTA complex. The analyte ion (with higher K_f) displaces EDTA from the metal and the metal is subsequently titrated with standard EDTA. For example, in the determination of Mn an excess of Mg EDTA chelate is added to Mn solution. The Mn ions quantitatively displace Mg from Mg-EDTA solution because Mn forms a more stable complex with EDTA. The freed Mg metal is then directly titrated with a standard solution of EDTA using Eriochrome black T indicator. Ca, Pb and Hg may also be determined by this method.

4. **Indirect Titration:** Certain anions that form precipitate with metal cations and do not react with EDTA can be analyzed indirectly. The anion is first precipitated with a metal cation and the precipitate is washed and boiled with an excess of disodium EDTA solution to form the metal complex. The protons from disodium EDTA are displaced by a

heavy metal and titrated with sodium alkali. Therefore, this method is also called alkalimetric titration. For example, barbiturates can be determined by this method.

12. Write the preperation and standardization of EDTA. And write the assay of calcium gluconate.

Answer: Preperation of 0.05 M EDTA:

Weigh accurately about 18.6g of Disodium EDTA, dissolve it in sufficient quantity of distilled water in 1000 ml volumetric flask and make the volume upto the mark with the help of distilled water.

Standardization:

Weigh accurately 0.8 gm granulated Zinc .Dissolve in 12 ml of dil HCL by gentle warming; add bromine water to remove impurities. Boil to remove excess bromine. Make up volume up-to 200 ml. From above stock solution remove 20 ml solution. Add 150 ml water Add sufficient ammonia solution buffer of PH 10 to it till it get alkaline. Add mod rent black-II indicator and titrate it against the EDTA. End point is green colour appearance.

13 Write the assay of calcium gluconate.

Answer: Weigh accurately about 0.5 g and dissolve in 50 ml of warm water; cool, add 5.0 ml of 0.05 M magnesium sulphate and 10 ml of strong ammonia solution and titrate with 0.05 M disodium EDTA using mordant black II mixture as indicator. From the volume of 0.05 M disodium EDTA required subtract the volume of the magnesium sulphate solution added.

IP factor:

1ml of the remainder of 0.05M disodium EDTA is equivalent to 0.02242 g of C12H22CaO14, H2O.

$Ca^{2+} + EDTA^{4-} \rightarrow CaEDTA^{2-}$

14. Write a note on masking and desmasking agents.

Answer: Titration Selectivity, Masking and Demasking Agents EDTA is a very unselective reagent because it complexes with numerous doubly, triply and quadruply charged cations. When a solution containing two cations which complex with EDTA is titrated without the addition of a complex-forming indicator, and if a titration error of 0.1% is permissible, then the ratio of the stability constants of the EDTA complexes of the two metals M and N must be such that $KM/KN \geq 106$

if N is not to interfere with the titration of M. strictly, of course, the constants KM and KN considered in the above expression should be the apparent stability constants of the complexes. If the complex-forming indicators are used, then for a similar titration error $KM/KN \geq 108$.

The following procedures will help to increase the selectivity:

- Use of masking and demasking agents
- pH control.
- Use of selective metal indicators.
- Classical separation

- Solvent extraction
- Removal of anions
- Kinetic masking

Use of masking and demasking agents:

Masking agents act either by precipitation or by formation of complexes more stable than the interfering ion-EDTA complex.

a) **Masking by Precipitation**: Many heavy metals e.g.- Co, Cu and Pb, can be separated either in the form of insoluble sulphides using Sodium sulphide, or as insoluble complexes using thioacetamide. These are filtered, decomposed and titrated with disodium EDTA. Other common precipitating agents are sulphate for Pb and Ba, oxalate for Ca and Pb, fluoride for Ca, Mg and Pb, ferrocyanide for Zn and Cu, and 8-hydroxy quinoline for many heavy metals. Thioglycerol (CH2SH.CHOH.CH2OH) is used to mask Cu by precipitation in the assay of lotions containing Cu and Zn.

b) **Masking by Complex formation:** Masking agents form more stable complexes with the interfering metal ions. The most important aspect is that the masking agent must not form complexes with the metal ion under analysis.

The different masking agents used are enlisted below:

- **Ammonium fluoride:** will mask aluminium, iron and titanium by complex formation.
- **Ascorbic acid:** is a convenient reducing agent for iron(III) which is then masked by complexing as the very stable hexacyanoferrate(II) complex. This latter is more stable and less intensely coloured than the hexacyanoferrate(III) complex.)
- **Dimercaprol (2,3-Dimercaptopropanol); (CH2SH.CHSH.CH2OH).** Cations of mercury, cadmium, zinc, arsenic, tin, lead and bismuth react with dimercaprol in weakly acidic solution to form precipitates which are soluble in alkaline solution. 15 All these complexes are stronger than the corresponding edetate complexes and are almost colourless. Cobalt, copper and nickel form intense yellowish-green complexes with the reagent under the above conditions. Cobalt and copper, but not nickel, are displaced from their edetate complexes by dimercaprol.) e to the preferential formation of a cyanohydrin), and) 2- and is specific)) ganese, it is best to amsk them with triethanolamine; similarly, mordant black II can be used in the presence of is the process in which the masked substance regains its ability to enter into a particular reaction. This enables to determine a series of metal ions in one solution containing Example of using masking and demasking agents in complexometry is the analysis of 3 metals, Cu, 3. taining mixture, only Cd is demasked and the EDTA titrates the sum of Ca and Cd. In this manner, the concentration of three ions is determined by 3 individual titrations.
- **Potassium cyanide** reacts with silver, copper, mercury, iron, zinc, cadmium, cobalt and nickel ions to form complexes in alkaline solution which are more stable than the corresponding edetate complexes, so that other ions, such as lead, magnesium, manganese and the alkaline earth metals can be determined in their presence. Of the metals in the first group mentioned, zinc and cadmium can be

demasked from their cyanide complexes by aldehydes, such as formaldehyde or chloral hydrate (du selectively titrated.

- **Potassium iodide** is used to mask the mercury(II) ion as (HgI4) for mercury. It can be used in the assay of mercury (II) chloride.
- **Tiron** (disodium catechol-3, 5-disulphonate) will mask aluminium and titanium as colourless complexes. Iron forms highly coloured complexes and is best masked as its hexacyanoferrate (II) complex.
- **Triethanolamine [N (CH2.CH2.OH)3]** forms a colourless complex with aluminium, a yellow complex with iron(III), the colour of which is almost discharged by adding sodium hydroxide solution, and a green manganese(III) complex which oxidizes mordant black II. For these reasons, if murexide is used in the presence of iron and man triethanolamine-aluminium complex.

DEMASKING:

It many cations. Cd and Ca. the following method of analysis is followed:

1. Direct titration of the mixture with the EDTA gives the sum of the 3 metals.
2. Cu and Cd may be masked with the addition of cyanide to the solution, leaving only Ca ion.
3. When formaldehyde or chloral hydrate is added to the

pH control Method: The formation of a metal chelate is dependent on the pH of the reaction medium. In weakly acid solution, the chelates of many metals are completely dissociated such as alkaline earth metals, whereas chelates of Bi, Fe3+ or Cr are readily formed at this pH. Thus, in acidic solution, Bi can be effectively titrated with a chelating agent in the presence of alkaline earth metals. This method is based upon the differences in stability of the chelates formed between the metal ions and the chelating agent.

Use of selective metal indicators: These indicators are the metal complexing agents which react with different metal ions under various conditions. Several selective metal indicators have been used and they are specific for a particular ion.

Classical separation: These may be applied if they are not tedious; thus the following precipitates may not be used for separations in which, after being re-dissolved, the cations can be determined complexometrically: CaC2O4, nickel dimethylglyoximate, Mg(NH4)PO4, 6H2O, and CuSCN.

Solvent extraction: This is occasionally of value. Thus, Zinc can be separated from copper and lead by adding excess of ammonium thiocyanate solution and extracting the resulting zinc thiocyanate with 4-methylpentan-2-one (isobutyl methyl ketone); the extract is diluted with water and the zinc content determined with EDTA solution.

Removal of Anions: Anions, such as orthophosphate, which can interfere in complexometric titrations, may be removed using ion exchange resins.

Kinetic masking: This is a special case in which a metal ion does not effectively enter into the complexation reaction because of its kinetic inertness. Thus the slow reaction of chromium (III) with EDTA makes it possible to titrate other metal ions which react rapidly, without interference from Cr (III); this is illustrated by the determination of iron (III) and chromium (III) in a mixture

15. What is redox titration?

Answer: A reaction in which one or more electrons are lost is known as *oxidation* and a reaction in which one or more electrons are gained is known as reduction. Accordingly, a substance which can accept one or more electrons is known as oxidizing agent and a substance which can donate one or more electrons is called reducing agent. Titrations of this type are called redox titrations. Thus, redox titrations are those involving transfer of electrons from the reducing agent to the oxidizing agent.

Potassium permanganate, potassium dichromate, ceric sulphate, etc., are the common oxidizing agents used in redox titrations. Oxalic acid, Mohr's salt and arsenious oxide are reducing agents commonly used in redox titrations.

16. What is per magnet titration

Answer: In this redox type of titration you will use a standard solution of potassium permanganate ($KMnO_4$) to determine the of iron (as Fe^{2+}) in an unknown solution. Permanganate ion reduces to a manganese(II) ion in the acidic solution. This reaction requires 5 electrons and 8 (!) hydrogen ions:

$$MnO_4^- + 8H^+ + 5\,e^- \rightarrow Mn^{2+} + 4H_2O$$

Only one electron is necessary to reduce Fe(III) to Fe(II)

$$Fe^{3+} + e^- \rightarrow Fe^{2+}$$

Therefore, 1 mole of MnO_4^-(the oxidizing agent) reacts with 5 moles of Fe^{2+} (the reducing agent) to form 5 moles of Fe^{3+} and 1 mole of Mn^{2+}. Thus, in net ionic form:

$$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$$

The 1:5 mole ratio with respect to the amounts of $MnO_4^-$and Fe^{2+} consumed will provide the stoichiometric basis for all of the calculations in this experiment

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II. Experimental Procedure.

A. Preparation of a Solution of $KMnO_4$

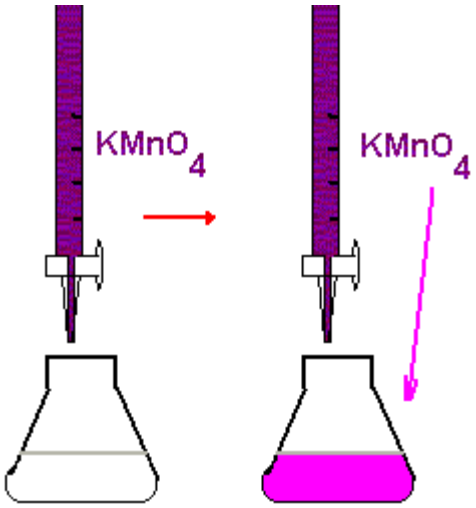
Note: This solution will be prepared in the stockroom and delivered to the students.

B. Titration of unknown Fe(II) solution

You receive a solution of unknown concentration in 100 mL volumetric flask. Dilute it carefully to the mark

1. Using a 10 mL pipet, transfer exactly 10.00 mL of an unknown solution into an Erlenmeyer flask.
2. Using a graduated cylinder, add 10 mL of 1 M H_2SO_4 to the flask.
3. Fill your buret with the **$KMnO_4$** solution and drain out enough so that the liquid level is just below the upper calibration mark and the buret tip is full. Read the initial volume from the calibration scale on the buret. This reading and all other buret readings should be estimated to the nearest 0.01 mL. The color of potassium permanganate is so deep that you hardly can see the lower menisk. Use the upper one to read the volumes.
4. Titrate the iron solution in the flask. The pinkish color produced by the first drop of excess **$KMnO_4$** signals the end point for the titration. Obtain the final volume reading

from the calibration scale on the buret.



Note: The color of MnO_4^- ion is so bright that NO indicator is necessary with permanganate titrations.

5. Repeat step 4 twice. The volume of **$KMnO_4$** solution used should agree with the first titration within 0.20 mL.

17. Explain potentiometric titration.

Answer: It is the procedure through which the quantity of the given test substance is determined by the measured addition of titrant until the entire test substance undergoes reaction. After the titration process, the potential difference between the two electrodes (namely the reference and indicator electrode) is measured in conditions where a thermodynamic equilibrium is maintained and the current passing through the electrodes does not disturb this equilibrium

Principle

Potentiometric titration is a laboratory method to determine the concentration of a given analyte. It is used in the characterization of acids. In this method, there is no use of a chemical indicator. Instead, the electric potential across the substance is measured.

Titration Method

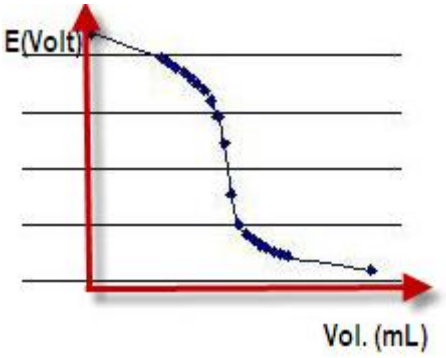
Potentiometric Titration is done via the usage of two electrodes – an indicator electrode and a reference electrode (generally a hydrogen electrode or a silver chloride electrode). One half-cell is formed with the indicator electrode and the ions of the analyte, which is generally an electrolyte solution. The other half-cell is formed by the reference electrode.

The overall cell potential can be calculated using the formula given below.

$$E_{cell}=E_{ind}-E_{ref}+E_{sol}$$

Where the potential drop between the indicator and reference electrodes over the electrolyte solution is given by E_{sol}.

The overall cell potential, E_{cell} is calculated in every interval where the titrant is measured and added. Now, a graph is plotted with the Potential difference on the Y-axis and the volume on the X-axis as shown below.



It can be observed from the graph that the electric potential of the cell is dependant on the concentration of ions which are in contact with the indicator electrode. Therefore, the E_{cell} is measured with each addition of the titrant.

Types of Potentiometric Titration

There are four types of titration that fall under the category of potentiometric titration, namely acid-base titration, redox titration, complexometric titration, and precipitation titration. A brief description of each of these types of titration is given below.

Acid-Base Titration: This type of potentiometric titration is used to determine the concentration of a given acid/base by neutralizing it exactly using a standard solution of base/acid whose concentration is known.

Redox Titration: This type of potentiometric titration involves an analyte and titrant that undergo a redox reaction. An example of this type of titration would be the treatment of an iodine solution with a reducing agent which produces iodide ion (a starch indicator is used to get the endpoint).

Complexometric Titration: This type of titration can also be referred to as chelatometry. In this method, a coloured complex is formed, indicating the end point of the titration. This method is used to determine a mixture of metal ions in a given solution.

Precipitation Titration: This type of titration involves a reaction between the given analyte and the titrant wherein an insoluble precipitate is formed. The end-point of this titration is noted when the addition of the titrant no longer forms a precipitate.

18. Types of stardard electrode and indicator electrode.

Answer:

Standard electrode

1.Hydrogen electrode

2.Silver chloride electrode

3.Calomel electrode

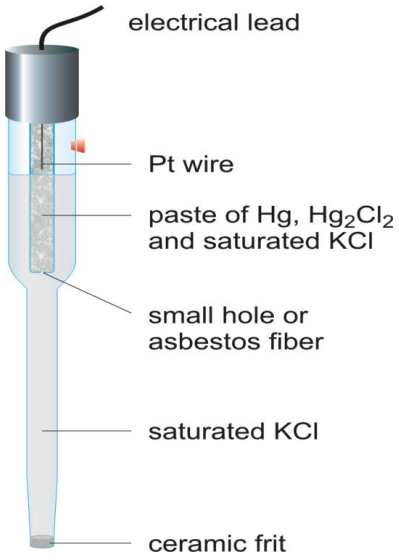
The Calomel Electrode

The calomel electrode was introduced by Ostwald in 1890. It is an electrode of the second kind (cf. Chap. II.9). As a reference electrode of fixed, well-known and very reproducible potential, it is still important today. In the simplest case, a single drop of mercury is placed in a small tube and is covered by mercury(I) chlo- ride (calomel Hg_2Cl_2)

Another possibility is to fill a small glass tube with a paste of mercury, mercury(I) chloride and potassium chloride solution The paste is in contact with a potassium chloride solution of con- stant activity. Mostly, a saturated potassium chloride solution is used and the paste additionally contains solid potassium chloride. The electrode net reaction can be formulated in the following way:

$$Hg + Cl^- \rightarrow \frac{1}{2}Hg_2Cl_2 + e^-$$

Thus, the potential of this electrode against the standard hydrogen electrode is given by the equation:



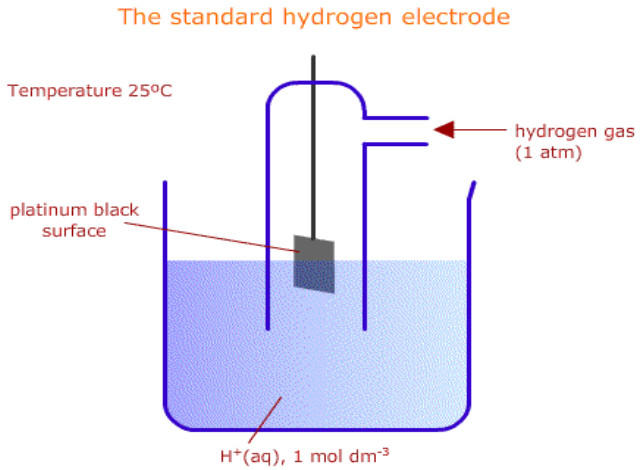
2. The Standard Hydrogen Electrode

A Standard Hydrogen Electrode (SHE) is an electrode that scientists use for reference on all half-cell potential reactions. The value of the standard electrode potential is zero, which forms the basis one needs to calculate cell potentials using different electrodes or different concentrations. It is important to have this common reference electrode just as it is important for the International Bureau of Weights and Measures to keep a sealed piece of metal that is used to reference the S.I. Kilogram.

What is a SHE made of?

SHE is composed of a 1.0 M $H^+(aq)$ solution containing a square piece of platinized platinum (connected to a platinum wire where electrons can be exchanged) inside a tube. During the reaction, hydrogen gas is then passed through the tube and into the solution causing the reaction:

$$2H^+(aq) + 2e^- <==> H_2(g).$$



3**. Silver silver choride electrode**

An electrode of this sort precipitates a salt in the solution that participates in the electrode reaction. This electrode consists, of solid silver and its precipitated salt AgCl. This a widely used reference electrode because it is inexpensive and not as toxic as the Calomel electrode that contains mercury. A Silver-Silver Chloride electrode is made by taking a wire of solid silver and coding it in AgCl. Then it is placed in a tube of KCl and AgCl solution. This allows ions to be formed (and the opposite) as electrons flow in and out of the electrode system.

$$AgCl(s)+e-\rightleftharpoons Ag+(aq)+Cl-(aq)(2)$$

Assignment-1

Question	Details	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Write a note on neutralization curve with example	2	CO2	3
2	Explain history of I.P	1	CO1	1
3	Explain types of errors	1	CO1	1
4	Define(any4) a) Normality b) molarity c) precision d) Accuracy	1/2	CO1	1
5	Explain limit test of iron and heavy metal	1	CO2	1

Class Test-1

Question	Details	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Explain primary standard and second and standard	2	1	CO1	1
2	How to prepare and standardize 1 M NaOH and 1M HCL	5	1	CO2/CO3	3
3	Explain sources of impurities	3	1	CO1	2
4	Explain following theories of acid base Indicators ***Resonance theory Ostwald theory***		2	CO1	1
5	Give neutralization curve of weak acid weak base with example.	5	2	CO2	3

Question Paper

Total No. of Questions : 3] SEAT No. : 2189 4

P3706 [Total No. of Pages : 4

[5452]-2002

First Year B. Pharmacy (Semester - I)

PHARMACEUTICAL ANALYSIS - I (BP102T)

(2018 Pattern)

Time : 3 Hours] *[Max. Marks : 75*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*

Q1) Multiple choice questions. **[20 × 1 = 20]**

i) As per pharmacopoeia the term "very soluble means"
a) Less than 1 part b) From 1 to 10 parts
c) From 10 to 30 parts d) From 30 to 100 parts

ii) As per pharmacopoeia the term "storage condition for cool "expressed as temperature in between
a) 2° to 8°C b) 8° to 25°C
c) 25° to 40°C d) None of above

iii) Normality is defined as
a) no of gram/Lit b) no of gram equivalent/Lit
c) no of mole/Lit d) no of equivalent/Lit

iv) Which of the following is not electrochemical method
a) Voltametry b) Polarography
c) Coulometry d) None of above

v) Relative standard deviation are also called as
a) Relative mean deviation b) Average deviation
c) Coefficient of variance d) None of above

vi) Fifth edition of Indian Pharmacopoeia is published in
a) 1985 b) 1996
c) 2007 d) 2010

vii) Titration of hydrochloric acid and sodium hydrochloride is the type of
a) Strong acid and weak base b) Strong acid and strong base
c) Weak acid and strong base d) Weak acid and weak base

viii) Amphiprotic solvent have following property
a) Protogenic b) Protophilic
c) Both of above d) None of above

ix) pH range of Phenolphthalein is in between
a) 5.2 - 6.8 b) 6.2 - 7.6
c) 6.8 - 8.4 d) 8.3 - 10.00

x) Meaning of LOD is
a) Loss on drying b) Limit of detection
c) Both of above d) Lower limit of detection

xi) Which of the following is strongest reducing agent?
a) Al b) Cu
c) Zn d) Mg

xii) Which ion is having lowest molar conductivity?
a) Ag^+ b) NO_3^-
c) OH^- d) CH_3COO^-

xiii) Bismuth is titrated in _____
a) Alkaline solution b) Acidic Solution
c) Neutral Solution d) Alcoholic solution

xiv) Main advantage of DME is _____
a) Surface is reproducible, smooth and continuously renewed
b) Capillary is very small in diameter
c) Mercury is very easily oxidized
d) It is used for analysis of reproducible or easily oxidizable substances

xv) Murexide is also known as _____
a) Ammonium purpurate b) Ammonium tartarate
c) Ammonium succinate d) Ammonium nitrate

xvi) Sodium nitrate cannot be analyzed gravimetrically because _____
a) All compounds containing sodium ions or nitrate ions are soluble
b) Sodium nitrate is insoluble
c) Sodium nitrate is an inert substance
d) The stability of sodium nitrate is very low

xvii) Indicator is not required in _____
a) Mohr's method b) Gay Lussac's method
c) Volhad's method d) Fajan's method

xviii) Polarograph is _____
a) Current Vs Volt graph b) DME
c) Instrument d) None of these

xix) Current used for measurement of conductance is _____
a) AC b) DC
c) Any one of these d) None of these

xx) Hydrogen electrode can be used as
a) Reference b) Indicator
c) Both of above d) None of these

OR

Answer the following **[10 × 2 = 20]**

a) Explain qualitative and quantitative analysis
b) Write about Nesslers cylinder as per IP
c) Give the criteria for selection of primary standard solution
d) Starch indicator give blue color with iodine, justify it
e) Give the role of thioglycolic acid in limit test of Iron
f) Define ligand and Chelate.
g) Enlist metal EDTA complexes.
h) What are organic precipitants?
i) Explain effect of dilution on specific and molecular conductance.
j) Classify different electrodes used in potentiometry.

Q2) Answer the following (any two) **[2 × 10 = 20]**

a) What is impurity? Explain in detail about different sources of impurity
b) Define limit test. Write principle, reaction, apparatus and procedure for limit test of Arsenic
c) What are Redox titrations? Explain half reaction and Nernst equation? Discuss assay of ferrous sulphate by cerimetry

Q3) Answer the following (any seven) **[7 × 5 = 35]**

a) Explain Mohr's Method
b) Write preparation and 0.1 N perchloric acid
c) Explain different methods of minimizing errors
d) Write a note on limit test of sulphate
e) Give the construction and working of Conductivity cell?
f) Write a note on masking and demasking agents
g) Give the difference between iodometry and iodimetry?
h) Write a note on indicator electrode
i) Write principle, reaction and procedure for assay of sodium chloride by volhards method.

▽▽▽▽

SUBJECT
BP103T PHARMACEUTICS-I

SCHEME
BP103T Pharmaceutics-I

SCHEME FOR TEACHING

Course of study for semester I

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP103T	Pharmaceutics-I	03	-	01	04
BP109P	Pharmaceutics-I	-	04	-	02

Schemes for Internal assessments and End semester examinations

Course Code	Course Name	Internal Assessment				End Semester Exams		Total Marks
			Sessional Exams					
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP103T	Pharmaceutics-I	10	15	1 Hrs	25	75	3 Hrs	100
BP109P	Pharmaceutics-I	5	10	4 Hrs	15	35	4 Hrs	50

Syllabus
BP103T PHARMACEUTICS-I (Theory)

UNIT – I **10 Hours**

- **Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- **Dosage forms:** Introduction to dosage forms, classification and definitions
- **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

UNIT – II **10 Hours**

- **Pharmaceutical calculations**: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
- **Powders:** Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
- **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

UNIT – III **08 Hours**

- **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.
- **Biphasic liquids:**
- **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.
- **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

UNIT – IV **08 Hours**

- **Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.
- **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

UNIV – V **07 Hours**

- **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams

and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms

BOOKS:

Text Books:

T1. Modern Pharmaceutics, 4th edition, revised and expanded, 2009, Edited by G S Banker and C T Rhodes, Published by Informa Healthcare USA Inc. New York.
T2. A R Paradkar, Introduction to Pharmaceutical Engineering, 10th edition, 2007, Published by Nirali Prakashan, Pune.
T3. Atmaram Pawar and R S Gaud, Modern Dispensing Pharmacy, 3rd edition reprint, 2010, Career Publications.
T4. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.

Reference Books:

R1. L V Allen, N G Popovich, H C Ansel, Ansel‟s Pharmaceutical dosage forms & Drug Delivery Systems, 9th edition, 2nd Indian reprint, 2011, Published by Lippincott Williams and Wilkins, Wolters Kluwer (India) Pvt. Ltd., New Delhi.
R2. M E Aulton, K Taylor, Pharmaceutics: The Science of Dosage Form Design, 2nd edition. Edited by M E Aulton, Published by Churchill Livingstone, 2001.
R3. Remington: The Science and Practice of Pharmacy, Volumes 1-2, 22nd edition, 2012, Edited by Allen L V, Adeboye A, Shane P D, Linda A F, Jointly published by Pharmaceutical Press and Philadelphia College of Pharmacy at University of the Sciences.
R4. Leon Lachman, Herbert A. Lieberman, Joseph L. Kanig, The Theory and Practice of Industrial Pharmacy. 3rd edition, 1986, CBS publishers and Distributors, New Delhi.
R5. Indian Pharmacopoeia, 2010, Volumes I, II & III, Published by The Indian Pharmacopoeia Commission, Ghaziabad, Government of India, Ministry of Health & Family Welfare.
R6. British Pharmacopoeia, 2009, Volumes I-IV and Veterinary, Published by British Pharmacopoeia Commission, the Stationary Office on behalf of Medicines and Healthcare products Regulatory Agency (MHRA), United Kingdom.
R7. United States Pharmacopeia 35 – National Formulary 30 by United States Pharmacopeia Convention, Volumes I-3.
R8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
R9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
R10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
R11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
R12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York

LESSION PLAN
BP103T PHARMACEUTICS-I (Theory)

Name of the faculty: Mr. V.A. Kashid

Bloom Levels (BL): 1. Remember 2. Understand 3. Apply 4. Create				
Lect. No.	**Topics / Sub- Topics**	**CO's Addressed**	**BL Level**	**Reference**
1	**Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career,	CO1	1	T1, R3, R5, R6, R7
2	Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.	CO1	2	
3	Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.	CO1	2	
4	**Dosage forms:** Introduction to dosage forms, classification and definitions	CO4	2	T1, T3, R2, R4
5	**Dosage forms:** Introduction to dosage forms, classification and definitions	CO4	2	
6	**Prescription:** Definition, Parts of prescription	CO2	2	T4, R3
7	Parts of prescription	CO2	2	
8	Handling of Prescription and Errors in prescription.	CO2	2	
9	**Posology:** Definition, Factors affecting posology.	CO2	2	T4, R3
10	**Posology:** Definition, Factors affecting posology.	CO2	2	
11	**Pharmaceutical calculations**: Weights and measures – Imperial & Metric system,	CO3	2	T4, R3
12	Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.	CO3	3	
13	Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.	CO3	3	
14	Calculations involving percentage solutions, alligation, proof spirit and	CO3	3	

	isotonic solutions based on freezing point and molecular weight.			
15	**Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations.	CO4	3	T1, T3, T4, R2, R4
16	Dusting powders, effervescent, efflorescent and hygroscopic powders.	CO4	3	
17	Eutectic mixtures and Geometric dilutions.	CO4	3	
18	**Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms.	CO4	2	T1, T3, R1, R2, R4
19	Excipients used in formulation of liquid dosage forms.	CO4	2	
20	Solubility enhancement techniques	CO4	2	
21	**Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops,	CO4	3	T1, T3, R2, R4
22	Enemas, Syrups, Elixirs, Liniments and Lotions.	CO4	3	
23	**Biphasic liquids:** **Suspensions:** Definition, advantages and disadvantages, classifications,	CO4	2	T1, T3, R1, R2, R4
24	Excipients used in suspension	CO4	2	
25	Preparation of suspensions;	CO4	3	
26	Flocculated and Deflocculated suspension & stability problems and methods to overcome.	CO4	2	
27	**Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion,	CO4	2	T1, T3, R1, R2, R4
28	Excipients used in emulsion	CO4	2	
29	Methods of preparation & stability problems and methods to overcome.	CO4	2	
30	Methods of preparation & stability problems and methods to overcome.	CO4	3	
31	**Suppositories**: Definition, types, advantages and disadvantages, types of bases.	CO4	2	T1, T3, R1, R2, R4
32	Methods of preparations. Displacement value & its calculations,	CO4	3	

	evaluation of suppositories.			
33	Methods of preparations. Displacement value & its calculations, evaluation of suppositories.	CO4	3	
34	**Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	CO3	2	T1, T3, T4, R2, R4
35	Physical incompatibilities	CO3	2	
36	Chemical incompatibilities	CO3	2	
37	Chemical incompatibilities	CO3	2	
38	Therapeutic incompatibilities	CO3	2	
39	**Semisolid dosage forms:** Definitions, classification,	CO4	2	T1, T3, R1, R2, R4
40	mechanisms and factors influencing dermal penetration of drugs.	CO4	2	
41	Excipients used in semi solid dosage forms.	CO4	2	
42	Excipients used in semi solid dosage forms.	CO4	2	
43	Preparation of ointments, pastes, creams and gels. Evaluation of semi solid dosages forms	CO4	3	
44	Preparation of ointments, pastes, creams and gels. Evaluation of semi solid dosages forms	CO4	3	
45	Evaluation of semi solid dosages forms	CO4	3	

Note: 1.Home Assignment will be given after completion of each unit.
2. Class Test I & II will be conduct as per the schedule of Academic Calendar.

Course Delivery, Objectives, Outcomes

BP103T PHARMACEUTICS-I

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon the completion of the course student shall be able to

- Know the history of profession of pharmacy
- Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
- Understand the professional way of handling the prescription
- Preparation of various conventional dosage forms

Course Outcomes (COs):

After successful completion of course student will able to

Upon the completion students are able to

CO1	Know and understand history and development of pharmacy profession.
CO2	Study and understand the basics of prescription and posology
CO3	Understand the pharmaceutical incompatibilities and pharmaceutical calculations
CO4	Study and understand the basics various dosage forms such as powders, monophasic and biphasic liquid dosage forms, suppositories etc.

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	1	1	1	1
CO2	3	2	2	2	1	-	-	-	-	-	3	3	1	1	1
CO3	3	2	2	3	2	-	-	-	-	-	3	3	1	2	1
CO4	3	3	3	3	2	-	-	-	-	-	3	3	3	3	1
Average	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**	**2**	**1**

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because CO1 gives the Highly basic knowledge of the pharmacy profession.
CO1 with PO2	CO1 is aligned with PO2 because it moderately deals with the development of pharmacy profession
CO1 with PO3	CO1 is aligned with PO3 because it slightly deals with the pharmacy profession
CO2 with PO1	CO2 is aligned with PO1 because it Highly deals with the basic pharmacy knowledge
CO2 with PO2	CO2 is aligned with PO2 because it deals basic knowledge of prescription and posology for community and hospital pharmacy
CO2 with PO3	CO2 is aligned with PO3 because it deals with prescription and posology related problem of pharma based system for public health and safety
CO2 with PO4	CO2 is aligned with PO4 relevant to theoretical as well as practical knowledge of dose calculation and analyze the prescription
CO2 with PO5	CO2 is aligned with PO5 because it slightly deals with modern tools for understanding and analyzing pharmacy practice.
CO 2with PO 11	CO2 is aligned with PO11 because it deals with application of prescription and posology knowledge at community pharmacy.
CO3 with PO1	CO3 is aligned with PO1 because it gives the Highly basic knowledge of the pharmacy.
CO3 with PO2	CO3 is aligned with PO2 because it deals with problem related to pharmaceutical incompatibilities and pharmaceutical calculation.
CO3 with PO3	CO3 is aligned with PO3 because it deals with pharmaceutical incompatibilities for pharma based system for public health and safety
CO3 with PO4	CO3 is aligned PO4 relevant to theoretical as well as practical knowledge related pharmaceutical calculation and incompatibilities
CO3 with PO5	CO3 is aligned with PO5 because it moderately deals with modern tools and techniques for pharmacy practice.
CO 3 with PO 11	CO3 is aligned with PO11 because it deals with application of pharmaceutical calculation and incompatibilities principles in pharmacy practice.
CO4 with PO1	CO4 is aligned with PO1 because it Highly deals with the basic pharmacy knowledge
CO4 with PO2	CO4 is aligned with PO2 because it slightly deals with the formulating and evaluating the pharmaceutical dosage form.
CO4 with PO3	CO4 is aligned with PO3 because it moderately deals with design and evaluation of pharma system
CO4 with PO4	CO4 is aligned with PO4 relevant to perform experiments, formulation and evaluation of pharmaceutical dosage form.
CO4 with PO5	CO4 is aligned with PO5 because it deals with modern tools and

	techniques for development of dosage form and its evaluation.
CO 4 with PO 11	CO4 is aligned with PO11 because it deals with Understanding and implementing theoretical and practical knowledge of development of pharmaceutical dosage form in pharmacy practice.
CO1 with PSO 1,2,3,4	Student apply fundamental knowledge to physical pharmaceutics to formulate, analyze and interpret the data of various pharma process for achieving the desired standards of dosage form so it correlate to PSO1 & PSO2,PSO3, PSO4
CO2 with PSO 1,2,3,4	Student apply fundamental knowledge to physical pharmaceutics to formulate, analyze and interpret the data of various pharma process for achieving the desired standards of dosage form so it correlate to PSO1 & +PSO2,PSO3, PSO4
CO3 with PSO 1,2,3,4	Student apply fundamental knowledge to physical pharmaceutics to formulate, analyze and interpret the data of various pharma process for achieving the desired standards of dosage form so it correlate to PSO1 & PSO2,PSO3, PSO4
CO4 with PSO 1,2,3,4	Student apply fundamental knowledge to physical pharmaceutics to formulate, analyze and interpret the data of various pharma process for achieving the desired standards of dosage form so it correlate to PSO1 & PSO2,PSO3, PSO4

Question Bank

BP103T PHARMACEUTICS-I (Theory)

Q. No	Questions	CO mapped	Bloom level
UNIT I			
Q.1	Write in detail on history of profession of pharmacy in India in relation to pharmacy education.	CO1	2
Q.2	Define prescription and explain different parts of prescription.	CO2	2
Q.3	Write in detail about handling and errors in prescription	CO2	2
Q.4	Write short notes on BP and USP.	CO1	2
Q.5	Write in brief about IP.	CO1	2
Q.6	Define posology and explain the factors affecting posology.	CO2	2
Q.7	Explain in brief about Young's and Clark's method for converting adult dose into child dose.	CO2	2
UNIT II			
Q.8	Write about imperial system of weights and measures.	CO3	2
Q.9	Write about displacement value and mention its significance.	CO3	2
Q.10	Write in detail about alligation method	CO3	3
Q.11	In what proportions does 50% of emulsion and 60% of emulsion required to 40% of emulsion?	CO3	3
Q.12	Write about alligation method and proof spirit. In what proportions must 70% of alcohol and 20% of alcohol required to make 30% of alcohol?	CO3	3
Q.13	Define and classify liquid dosage forms. Write about different excipients used in liquid dosage forms.	CO4	2
Q.14	Write about Metric system of weights and measure in brief.	CO3	2
Q.15	What are powders? Write the advantages and disadvantages of powders.	CO4	2
Q.16	Write about Dusting and Effervescent powders in brief.	CO4	2
Q.17	Write about preparation method of simple syrup as per IP.	CO4	3
Q.18	Write in brief about eutectic mixtures.	CO4	2
Q.19	What are liquid dosage forms and explain the advantages and disadvantages of liquid dosage forms.	CO4	2
UNIT III			
Q.20	Write about preparations of mouthwashes and lotions.	CO4	2
Q.21	Write about mouth washes and gargles in brief.	CO4	2
Q.22	Write in brief about Elixirs and Liniments.	CO4	2
Q.23	Define emulsion and mention a note on emulsifying agents	CO4	2

Q.24	Mention in detail about stability problems encountered by suspensions	CO4	2
Q.25	What are Emulsions? Mention the stability problems of emulsions.	CO4	2
Q.26	Define suspensions. Explain about flocculated and deflocculated suspension.	CO4	2
Q.27	Define emulsions and mention any two methods of preparation of emulsions	CO4	2
UNIT IV			
Q.28	Define and classify different types of incompatibilities.	CO3	2
Q.29	Define incompatibility and explain about physical incompatibility.	CO3	2
Q.30	Write about different types of suppositories bases and evaluation of suppositories.	CO4	2
Q.31	Explain different types of suppositories bases used in preparation of suppositories	CO4	2
Q.32	Write about chemical and therapeutic incompatibility with one example to each	CO3	2
UNIT V			
Q.33	Write about excipients used in semi solid dosage forms	CO4	2
Q.34	Write in brief about creams and gels.	CO4	2
Q.35	Explain evaluation methods for semi solid dosage forms.	CO4	2
Q.36	Define ointment and explain preparation of ointments.	CO4	2
Q.37	Explain the mechanism involved in dermal penetration of drugs	CO4	2

Multiple Choice Question- I
(AY 2020-21)

Semester: I **Duration: 15 min**

Subject: Pharmaceutics-I (BP103T) **Max. Marks: 10 M**

Note: All Questions are compulsory

1. Which of the following is a type of Oral dosage form?
(a) Aerosol
(b) Nebulizer
(c) Subcutaneous administration
(d) Tablet

2. What do you mean by ophthalmic dosage form?
(a) Dosage form for the drugs administered through the ears.
(b) Dosage form for the drugs administered through the eyes.
(c) Dosage form for the drugs administered through the nose.
(d) Both for the eyes and the nose.

3. Which of the following is a biphasic liquid dosage form?
(a) Syrup
(b) Linctus
(c) Suspension
(d) Lotion

4. Which of the following dosage form contains alcohol
(a) Elixirs
(b) Syrups
(c) Emulsions.
(d) Ointments

5. The solution contains 3gr of a drug per fluid ounce. What is the % w/v of the solution.
(a) 0.66%
(b) 0.59%
(c) 10%
(d) 1.0%

6. The Latin term Pulvis represents
(a) an ointment
(b) an emulsion
(c) a powder
(d) Suspension

7. Which of the following is a reason for therapeutic incompatability?
(a) Change in pH
(b) Liquifaction
(c) Contraindication
(d) Immiscibility

8.Which of the following is an example for food drug interaction?
(a) Caffine, Tetracycline

(b) Milk, Tetracycline
(c) Aspirin, Paracetamol
(d) Mik, Caffine
9. Liniment having which of the following property
(a) Protective
(b) antitussive
(c) Counter irritant
(d) Lubricant
10. Which of the following is a type of Inhalational dosage form?
(a) Ointment
(b) Aerosol
(c) Injection
(d) Tablet

Multiple Choice Question- II

Semester: I **Duration: 15 min**

Subject: Pharmaceutics-I (BP103T) **Max. Marks: 10 M**

Note: All Questions are compulsory

1. What is the meaning of the Latin term post cibos?
(a) with meals
(b) before meals
(c) with milk
(d) after meals
2. Eutectic mixtures are coming under
(a) Bulk Powders
(b) Dusting Powders
(c) Special Powders
(d) Dental Powders
3. Which of the following is multiple emulsion?
(a) O/W
(b) O/W/O
(c) W/O/W
(d) Both b & C
4. Displacement value is considered in the following dosage form
(a) Ointments
(b) Gels
(c) Suppositories
(d) Emulsions
5. Anti pruretic means
(a) releives pain
(b) releives itching
(c) releives constipation
(d) releives inflammation
6. Nomo grams are used for the determination of which of the following.
(a) Height of the individual
(b) weght of individual
(c) Body Surface area
(d) pathological state
7. Based on which of the following parameter Dosage forms are classified
(a) Route of administration
(b) Physical form
(c) chemical form
(d) Both a & b
8. Antitussive means
(a) Reduces fever
(b) Reduces inflammation
(c) Reduces Cough

(d) Reduces Flu

9. Hygroscopic nature means

(a) Removal of Moisture

(b) Absorbs Moisture

(c) Removal of iodine

(d) Absorbs iodine

10. The symbol Rx represents the following

(a) Inscription

(b) Supersciption

(c) Subsciption

(d) Signatura

Assignment No.1 [A.Y. 2020-21]

Unit: 1&2 **Class: B.Pharm. (Sem. I)**

Subject: Pharmaceutics-I (BP103T) **Total Marks: 20**

Q No.	Questions	Max. Marks	Unit no.as per syllabus	CO Mapped	Bloom's Taxonomy Level
01.	Write in detail on history of profession of pharmacy in India in relation to pharmacy Education	04	1	CO1	2
02.	Define prescription and explain different parts of prescription	04	1	CO2	2
03.	Write about Metric system of weights and measure in brief.	04	2	CO3	2
04.	Define and classify liquid dosage forms. Write about different excipients used in liquid dosage forms	04	2	CO4	2
05.	What are powders? Write the advantages and disadvantages of powders.	04	2	CO4	2

Assignment No.2 [A.Y. 2020-21]

Unit: 3&4 **Class: B.Pharm. (Sem. I)**

Subject: Pharmaceutics-I (BP103T) **Total Marks: 20**

Q No.	Questions	Max. Marks	Unit no.as per syllabus	CO Mapped	Bloom's Taxonomy Level
01.	Define emulsion and mention a note on emulsifying agents	04	3	CO4	2
02.	Write about preparations of mouthwashes and lotions.	04	3	CO4	2
03.	Define and classify different types of incompatibilities. Write about chemical and therapeutic incompatibility with one example to each	04	4	CO3	2
04.	Explain different types of suppositories bases used in preparation of suppositories	04	4	CO4	2
05.	Write about excipients used in semi solid dosage forms	04	5	CO4	2

CLASS TEST- I

Semester: I **Duration: 1 hour**

Subject: Pharmaceutics-I (BP103T)) **Max. Marks: 20M**

Note: 1. All Questions are compulsory

2. Bloom's Taxonomy level: Bloom Levels (BL) : 1. Remember 2. Understand 3. Apply 4. Create

3. All questions are as per course outcomes

4. Assume suitable data wherever is required.

Question No.	Questions	Max. Marks	Unit no. as per syllabus	CO Mapped	Bloom's Taxonomy Level
01.	Write short notes on BP and USP.	**05**	**1**	**CO1**	**2**
02.	Write about displacement value and mention its significance	**05**	**2**	**CO3**	**2**
03.	Define posology and explain the factors affecting posology.	**05**	**1**	**CO2**	**2**
04.	Write about Dusting and Effervescent powders in brief	**05**	**2**	**CO4**	**2**

CLASS TEST- II

Semester: I **Duration: 1 hour**

Subject: Pharmaceutics-I (BP103T) **Max. Marks: 20M**

Note: 1. All Questions are compulsory

2. Bloom's Taxonomy level: Bloom Levels (BL) : 1. Remember 2. Understand 3. Apply 4. Create

3. All questions are as per course outcomes

4. Assume suitable data wherever is required.

Questio No.	Questions	Max. Marks	Unit no. as per syllabus	CO Mapped	Bloom's Taxonomy Level
01.	Mention in detail about stability problems encountered by suspensions	**05**	**3**	**CO4**	**2**
02.	Write about different types of suppositories bases and evaluation of suppositories.	**05**	**4**	**CO4**	**2**
03.	Write in brief about Elixirs and Liniments.	**05**	**3**	**CO4**	**2**
04.	Explain evaluation methods for semi solid dosage forms.	**05**	**5**	**CO4**	**2**

University Question Paper

Total No. of Questions : 3] SEAT No. :

P3707 [Total No. of Pages : 4

[5452]-2003

First Year B. Pharm (Semester - I)

PHARMACEUTICS - I

(2018 Pattern)

Time : 3 Hours] *[Max. Marks : 75*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Figures to the right indicate full marks.*

Q1) Multiple choice questions (MCQ) select the proper choice. **[20 × 1 = 20]**

i) The doses of Vitamine are generally given as _____. [02]

a) mg/kg body wt b) sex

c) I.U. d) divided dosage

ii) Dose of substance is given as 250mg four times a day on the basis of _____. [02]

a) Weight b) BSA

c) Elimination time d) None

iii) _____ called as Legend prescription. [02]

a) Modern b) NHS

c) CGHS d) Leaflet

iv) _____ part of prescription will give details of dose schedule. [02]

a) Inscription b) Subscription

c) Sigma d) Superscription

v) Compounding & dispensing prescription are written in [02]

a) English b) Latin

c) French d) German

P.T.O.

vi) Dose on BSA is based on _____. [C02]

a) Weight b) Hight & weight

c) Sex d) Age

vii) Dose is a _____ quantity. [C02]

a) Related b) Changed

c) Fixed d) Average

viii) $COCl_2$ test for identification of emulsion is based on _____. [C04]

a) Solubility b) M.P.

c) Moisture content d) Poly morph

ix) Alligation is a tech used for _____. [C04]

a) Proof spirit b) Dilution

c) % solutions d) Isotonicity

x) Drug-Drug interaction is _____ type of incompatibility. [C03]

a) Chemical b) Physical

c) Therapeutic d) Unintentional

xi) Two solids after mixing forms the Liquid is called _____. [C03]

a) Polymorph b) Solution

c) Eutectic d) Dispersion

xii) Creams are basically _____. [C04]

a) Emulsion b) Suspension

c) Lotions d) Liquids

xiii) As per B.P. standard 100° proof spirit is _____% alcohol. [C04]

a) 57.1% v/v b) 50% v/v

c) 49.28% w/v d) 57.1% w/v

xiv) Effervescent granules contain slightly excess acid because _____. [C04]

a) It is pleasant b) Stable

c) Complete reaction d) Preservative

xv) Dusting powder is also called as _____ powder. [C04]

a) Divided b) Talcum

c) Effervescent d) Dredged

xvi) The dose of Ear drop/Nasal drop is given as _____. [C04]

a) Micro liters b) Mililiter

c) Drop d) None

xvii) Solutions having freezing point _____ is isotonic with tear secretion. [C03]

a) 0.52°C b) 5.2°C

c) 0.52°F d) -0.52°C

xviii) The powder which transfer the moisture to another powder is called _____. [C04]

a) Efflorescent b) Hygroscopic

c) Deliquescent d) Effervescent

xix) Lanoline is a _____ type of ointment base. [C04]

a) Absorption b) Oily

c) Oleogienous d) Aqueous

xx) The most stable form of coeabutter is _____. [C04]

a) Alfa b) Gamma

c) Bita d) Lamda

Q2) Answer any two. [2 × 10 = 20]

a) Define prescription. Explain its various parts with suitable example. [C02]

b) Explain various types of suppositories and its bases. Give the importance of displacement value in preparation with example. [C04]

c) Define and classify the Incompatibility. Explain physical incompatibility. [C03]

Q3) Solve any seven. [7 × 5 = 35]

a) Justify, "syrup I. P is more concentrated than syrup USP". [C04]

b) Classify emulsion by various ways. Explain aceasia emulsion. [C04]

c) Classify the suspending agents. Explain floculated & defloculated suspension. [C04]

d) Define ointment. Explain its various bases with example. [C04]

e) Highlight your views on carrier development of pharmacist in India. [C01]

f) In what proportion water is added to 75%, 60% & 50% POH. per magnet solution to convert 30% solution. [C03]

g) The dose of a drug is 40 mg for an adult. What will be the dose for 15 month old infant and 04 years child. [C03]

h) Explain various factor which affect the dose. [C02]

i) Justify the process for preparation of sodium citro tartarate effervescent granules. [C04]

▽▽▽▽

Total No. of Questions : 3] SEAT No. :

P3398 [Total No. of Pages : 2

[5552] - 2003
First Year B.Pharmacy (Semester - I)
PHARMACEUTICS - I
(2018 Pattern)

Time : 3 Hours] *[Max. Marks : 75*

Instruction : Answer all the questions.

Q1) Answer the following : [10 × 2 = 20]

a) Differentiate between ointment and paste. [C04]

b) Differentiate flocculated. & deflocculated suspension. [C04]

c) Classify the powder by various ways. [C04]

d) Give solubility enhancemnet techique of lig [C04]

e) Give the labelling conditions of mouthwash and gargle. [C04]

f) Give test for identification of emulsion. [C04]

g) What is Eutectic mixture. [C04]

h) Give the organisation of pharmacy. [C01]

i) Define porology. Enlist factors which affect dose. [C02]

j) Give the development of Indian Pharmacopoeia. [C01]

Q2) Answer any two. [2 × 10 = 20]

a) Explain the obsorption of semilids. Give its evalution. [C04]

b) Define and classify the Incompatibility. Explain chemical Incompatibility. [C03]

c) Classify the bases of suppository. Explain how the displacement value of substance is calculated. [C04]

P.T.O.

Q3) Solve any Seven **[7 × 5 = 35]**

a) How will you convert 80 u/p & 30 o/p in % strength. similary 80% & 30% alcohol in proof strength / spirits. [C03]

b) Discuss various formulation aspects of suspensions. [C04]

c) Explain Therapeutic Incompatibility. [C03]

d) Classify emulsion by various ways. Give its stability parameters. [C04]

e) Classify the powders. Explain with example divided powders. [C04]

f) Explain importance of stock's law in stability of dispense system. [C04]

g) Give the evaluation of suppository. [C04]

h) Justify the role of pharmacist by his organisational structure. [C01]

i) How much water is to be added to 400ml 30%, 500ml 20 % & 600 ml 80% alcohol to make 10% alcohol. [C03]

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SUBJECT

BP104T PHARMACEUTICAL INORGANIC CHEMISTRY

SCHEME

305T Pharmaceutical Inorganic Chemistry

SCHEME FOR TEACHING

Course of study for semester III

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP104T	Pharmaceutical Inorganic Chemistry – Theory	03	04	01	08

SCHEME FOR INTERNAL AND END SEMESTER EXAMINATIONS

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Assessment	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	01 hrs	25	75	03 hrs	100
BP110P	Pharmaceutical Inorganic Chemistry – Practical	05	10	04 hrs	15	35	04 hrs	50

SYLLABUS

BP104T Pharmaceutical Inorganic Chemistry

Sr. No	Topics	Hrs
01	**UNIT 1** Introduction: **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate	10
02	**UNIT II** **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. **Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement	10
03	**UNIT III** Gastrointestinal agents **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture **Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite **Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	10
04	**UNIT IV** Miscellaneous compounds **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics**: Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333 **Astringents**: Zinc Sulphate, Potash Alum	08
05	**UNIT V** **Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances	07

RECOMMENDED BOOKS

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.

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

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition

4. M.L Schroff, Inorganic Pharmaceutical Chemistry

5. Bentley and Driver's Textbook of Pharmaceutical Chemistry

6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry

7. Indian Pharmacopoeia

LESSION PLAN

Sub: BP104T Pharmaceutical Inorganic Chemistry

Name of the faculty: Dr. Charushila J. Bhangale

Lecture No	Description	Teaching Methodology	References	COs	POs
1	Introduction of Pharmaceutical Inorganic Chemistry	chalk and talk	Indian Pharmacopoeia	CO1	PO1
2	Introduction of Impurities in pharmaceutical substances:	chalk and talk	Anand & Chatwal	CO1	PO1
3	History of Pharmacopoeia	chalk and talk	Indian Pharmacopoeia	CO1	PO2
4	Sources and types of impurities	chalk and talk	Anand & Chatwal	CO1	PO1
5	Sources and types of impurities	chalk and talk	Anand & Chatwal	CO1	PO1
6	principle involved in the limit test for Iron, Arsenic, Lead and Heavy metals	chalk and talk	Indian Pharmacopoeia	CO1	PO1
7	principle involved in the limit test for modified limit test for Chloride and Sulphate	chalk and talk	Indian Pharmacopoeia	CO1	PO1
8	principle involved in the limit test for Chloride, Sulphate	Power point presentation	Indian Pharmacopoeia	CO1	PO1
9	Introduction of **Acids, Bases and Buffers**	chalk and talk	Anand & Chatwal	CO2	PO4
10	Buffer equations and buffer capacity in general, buffers in pharmaceutical systems	chalk and talk	Anand & Chatwal	CO2	PO1
11	preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.	Power point presentation	Anand & Chatwal	CO2	PO1
12	**Major extra and intracellular electrolytes**: Functions of major physiological ions	chalk and talk	Anand & Chatwal	CO2	PO2

13	Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate*	Power point presentation	Anand & Chatwal	CO1	PO2
14	**Dental products**: Dentifrices, role of fluoride in the treatment of dental caries	Demonstration	Anand & Chatwal	CO2	PO2
15	Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	Power point presentation	Anand & Chatwal	CO2	PO1
16	Gastrointestinal agents	chalk and talk	Anand & Chatwal	CO2	PO2
17	**Acidifiers:** Ammonium chloride* and Dil. HCl	chalk and talk	Anand & Chatwal	CO2	PO3
18	**Antacid:** Ideal properties of antacids, combinations of antacids	chalk and talk	Anand & Chatwal	CO1	PO2
19	**Antacid:**Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture	chalk and talk	Anand & Chatwal	CO2	PO2
20	**Cathartics:** Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite	chalk and talk	Anand & Chatwal	CO2	PO2
21	**Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	chalk and talk	Anand & Chatwal	CO2	PO1
22	**Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	Power point presentation	Anand & Chatwal	CO1	PO1
23	**Antimicrobials**: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	chalk and talk	Anand & Chatwal	CO2	PO2
24	Miscellaneous compounds **Expectorants:** Potassium iodide, Ammonium chloride*.	chalk and talk	Anand & Chatwal	CO2	PO2

25	Miscellaneous compounds **Expectorants:** Potassium iodide, Ammonium chloride*.	chalk and talk	Anand & Chatwal	CO2	PO2
26	**Emetics**: Copper sulphate*, Sodium potassium tartarate	Power point presentation	Anand & Chatwal	CO1	PO2
27	**Emetics**: Copper sulphate*, Sodium potassium tartarate	chalk and talk	Anand & Chatwal	CO1	PO1
28	**Haematinics:** Ferrous sulphate*, Ferrous gluconate	chalk and talk	Anand & Chatwal	CO2	PO2
29	**Haematinics:** Ferrous sulphate*, Ferrous gluconate	chalk and talk	Anand & Chatwal	CO2	PO2
30	**Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333	chalk and talk	Anand & Chatwal	CO2	PO2
31	**Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333	chalk and talk	Anand & Chatwal	CO2	PO2
33	**Astringents**: Zinc Sulphate, Potash Alum	chalk and talk	Anand & Chatwal	CO1	PO1
34	**Astringents**: Zinc Sulphate, Potash Alum	chalk and talk	Anand & Chatwal	CO1	PO2
35	**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations	chalk and talk	Anand & Chatwal	CO1	PO2
36	**Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations	chalk and talk	P. Gundu Rao	CO1	PO1
37	Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions	chalk and talk	P. Gundu Rao	CO1	PO2
38	Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions	chalk and talk	P. Gundu Rao	CO1	PO1
39	Precautions & pharmaceutical application of radioactive substances.	chalk and talk	P. Gundu Rao	CO2	PO3
40	precautions & pharmaceutical application of radioactive substances.	chalk and talk	P. Gundu Rao	CO2	PO2
41	Introduction of Impurities in pharmaceutical	chalk and talk	P. Gundu Rao	CO2	PO2

	substances:				
42	Introduction of Impurities in pharmaceutical substances:	chalk and talk	P. Gundu Rao	CO2	PO2
43	History of Pharmacopoeia	Power point presentation	P. Gundu Rao	CO3	PO3
44	History of Pharmacopoeia		P. Gundu Rao	CO3	PO2
45	History of Pharmacopoeia	chalk and talk	P. Gundu Rao	CO3	PO1

Note: 1. Home Assignment will be given after completion of each unit.

2. Class Test I & II will be conduct as per the schedule of Academic Calendar.

COURSE DELIVERY, OBJECTIVES, OUTCOMES

BP104T. Pharmaceutical Inorganic Chemistry

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon completion of course student shall be able to

1. To know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
2. To understand the medicinal and pharmaceutical importance of inorganic compounds
3. To identify unknown inorganic compounds by qualitative analysis.

Course Outcomes (COs):
After successful completion of course student will able to

CO1	To understand**[L1: Knowledge]** principle, and to know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals inorganic chemistry
CO2	To understand the medicinal and pharmaceutical importance of inorganic compounds**[L1: Knowledge]** and practical skills of inorganic compounds **[L3: Application]**
CO3	Discuss and Know pharmaceuticals inorganic compound **L2:comprehension]** and to understands its chemical and physical properties**[L3: Application]**

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	-	-	1	-	1	1	2	3	1	2	1
CO2	3	2	1	1	-	2	1	1	-	-	-	3	2	1	1
CO3	3	1	1	2	1	1	1	2	-	-	-	3	1	1	2

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because practical gives a technical knowledge of separation technique
CO1 with PO2	CO1 is aligned with PO2 because it deals with organic theoretical reactions
CO1 with PO3	CO1 is aligned with PO3 because it deals with the design of new inorganic chemical reaction methods
CO1 with PO4	CO1 is aligned with PO4 because it deals with the development of technical knowledge of inorganic manufacturing method
CO1 with PO7	CO1 is aligned with PO7 because it deals with the design of new inorganic chemical reaction methods
CO1 with PO9	CO1 is aligned with PO9 because it moderately deals with the basic knowledge of inorganic synthesis of new drug
CO1 with PO10	CO1 is aligned with PO10 because it deals with the technical knowledge of inorganic chemistry subject
CO1 with PO11	CO1 is aligned with PO11 because it deals with understanding of the theoretical concept of the techniques and procedures of separation of inorganic mixture.
CO2 with PO1	CO2 is aligned with PO1 because it moderately deals with the basic knowledge of inorganic synthesis
CO2 with PO2	CO2 is aligned with PO2 because it moderately deals with the guideline of Manufacturing Process.
CO2 with PO3	CO2 is aligned with PO3 because analysis of simple process to meet desired product is useful for the design of new process to achieve new inorganic chemical process.
CO2 with PO4	CO2 is aligned with PO4 because it deals with the technical knowledge of inorganic chemistry subject
CO2 with PO6	CO2 is aligned with PO6 because it deals with understanding of the theoretical concept of the techniques and procedures of separation of inorganic mixture.
CO2 with PO7	CO2 is aligned with PO7 because it deals with the development of technical knowledge of manufacturing method
CO2 with PO8	CO2 is aligned with PO8 because it deals with the development of new process and procedure for manufacturing new drug
CO3 with PO1	CO3 is aligned with PO1 because for method of reaction and the knowledge of new product as per guideline of Good Manufacturing Practices.
CO3 with PO2	CO3 is aligned with PO2 because new product method is depends on various chemical parameter and it deals with the formulation of product
CO3 with PO3	CO3 is aligned with PO3 because for any design of any new process system needs to study the formulation.
CO3 with PO4	CO2 is aligned with PO5 because it moderately deals with the guideline of Manufacturing Process.
CO3 with PO5	CO3 is aligned with PO5 because for any design of any new process system needs to study the formulation.
CO3 with PO6	CO4 is aligned with PO6 because it deals with the development of technical knowledge of manufacturing method
CO3 with	CO1 is aligned with PO7 because it deals with the design of new

PO7	chemical reaction methods
CO3 with PO8	CO2 is aligned with PO8 because it moderately deals with the basic knowledge of inorganic synthesis of new drug
CO1 with PSO1	CO1 is aligned with PSO1 because it deals with the technical knowledge of subject
CO1 with PSO2	CO1 is aligned with PSO2 because it deals with understanding of the theoretical concept of the techniques and procedures used for chemistry
CO1 with PSO3	CO1 is aligned with PSO3 because it defines the method used for the chemistry of finished product and also defines the process used for chemistry.
CO1 with PSO4	CO1 is aligned with PSO4 because it deals with the knowledge of technique one can define the process to meet desired need
CO2 with PSO1	CO2 is aligned with PSO1because it deal with the theoretical knowledge of the new chemistry technique
CO2 with PSO2	CO2 is aligned with PSO2 because it deals with understanding of the practical skills
CO2 with PSO3	CO2 is aligned with PSO3 because it defines the analysis of process and finished product in limits
CO2 with PSO4	CO2 is aligned with PSO3 because it deals with the defining the procedure for the new product which meet the desired standard of safety for humans
CO3 with PSO1	CO3 is aligned with PSO1 because it deals with the development of technical knowledge of safety measures instruments
CO3 with PSO2	CO3 is aligned with PSO2 because it deals with the development of new process and procedure for manufacturing new drug with understanding of its limitation
CO3 with PSO3	CO3 is aligned with PSO3 because it deals with the evaluation of drugs and finished products lies in permissible limit
CO3 with PSO4	CO3 is aligned with PSO4 because it deals with the designing of method for stable formulation which meet desire needs of safety for humans
CO4 with PSO1	CO3 is aligned with PSO1 because it deals with the theoretical knowledge of the chemistry technique
CO4 with PSO2	CO3 is aligned with PSO1 because it deals it deal appropriate methods, procedures, resources and modern pharmacy-related computing tools
CO4 with PSO3	CO3 is aligned with PSO1 because it deals analyze and evaluate chemical substances and finished products
CO4 with PSO4	CO3 is aligned with PSO1 because it deals design a system, component or process to meet desired needs within realistic constraints

QUESTION BANK

Sr.no	Topic	CO mapped	Bloom level
Q.1	I. Multiple Choice Questions (10) Impurities in pharmaceutical preparation may be due to following sources: (a) Raw material (b) Manufacturing process (c) Chemical instability (d) All of the above Ans. (d)	CO1	2
Q.2	Pharmaceutical buffer system could be categorizes into (a) 1 (b) 2 (c) 3 (d) none of these Ans. (b)	CO1	2
Q.3	Fluoride inhibits caries formation via (a) Increase acid solubility of enamel (b) Bacterial inhibition (c) Both the above (d) Decrease acid solubility of enamel Ans. (d)	CO2	1
Q.4	In Bronsted-Lowry concept acid is (a) Proton donor (b) electron donor (c) proton accepter (d) electron accepter Ans. (a)	CO1	2
Q.5	Hypochloremia can be caused by (a) salt losing nephritis (b) metabolic acidosis (c) both (a) and (b) (d) metabolic alkalosis Ans. (c)	CO1	2
Q.6	In physiological acid-base imbalance K excretion will be decreased (a) the amount of Na reaching distal tubule is low (b) the proton secretion by kidney tubule is increased (c) both (a) and (b) (d) none of the above Ans. (c)	CO1	2
Q.7	Calcium gluconate is prepared by (a) lactic acid and CaCO3 (b) oxalic acid and CaCO3 (c) gluconic acid and CaCO3 (d) gluconic acid and Ca(OH)2 Ans. (c)	CO2	3
Q.8	Which one of the followings is used as systemic alkalizer? (a) Sodium chloride (b) Sodium bicarbonate (c) Sodium sulphate (d) Sodium acetate Ans. (b)	CO1	2
Q.9	The principle function of chloride is (a) maintenance of proper hydration (b) maintenance of osmotic pressure (c) normal electrolytic balance (d) all of the above Ans. (d)	CO1	2
Q.10	The advantage of sodium lactate over sodium	CO3	3

	bicarbonate (a) rapidly metabolized (b) it may be sterilized by boiling (c) both of the above (d) none of the above Ans. (c)		
Q.11	What is hardness of water? Explain in detail to remove temporary and permanent hardness of water?	CO2	3
Q.12	Classify the GIT agent with example of each class and write in detail about saline cathartics?	CO2	3
Q.13	Write preparation properties and uses of Calcium carbonate?	CO3	3
Q.14	Explain in brief about Acidifying Agents?	CO2	3
Q.15	*Write preparation properties and uses of Ferrous Sulfate?*	CO2	3
Q.16	Explain in detail about Limit test of Arsenic?	CO2	3
Q.17	Write a note on Limit Test of Iron	CO2	3
Q.18	Write physiological role of sodium and chloride?	CO3	3
Q.19	What are topical Agent and discuss the mechanism of topical antimicrobial agent? Discuss uses, assay and properties of zinc oxide and Hydrogen peroxide?	CO2	3
Q.20	What is expectorant?	CO2	3
Q.21	Explain Mode of action for expectorant and Aluminium chloride as Expectorants?	CO1	1
Q.22	Discuss raw material as sources of impurities?	CO2	2
Q.23	Explain properties and uses of boric acid and copper sulfate?	CO3	1
Q.24	Explain different types of Ash value in term of impurities?	CO1	2

MODEL ANSWER

Q.1. What is hardness of water? Explain in detail to remove temporary and permanent hardness of water?

Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce lather. Hard water often produces a noticeable deposit of precipitate (e.g. insoluble metals, soaps or salts) in containers, including "bathtub ring". It is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium Cations, although other cations (e.g. aluminium, barium, iron, manganese, strontium and zinc) also contribute. Hardness is most commonly expressed as milligrams of calcium carbonate equivalent per litre.

Sources The principal natural sources of hardness in water are dissolved polyvalent metallic ions from sedimentary rocks, seepage and runoff from soils. Calcium and magnesium, the two principal ions, are present in many sedimentary rocks, the most common being limestone and chalk. They are also common essential mineral constituents of food. As mentioned above, a minor contribution to the total hardness of water is also made by other polyvalent ions, such as aluminium, barium, iron, manganese, strontium and zinc.

Removal of Hardness from Water | Water Softeners:

Removal of hardness from water can be done using different methods that can be grouped into two: chemical (use of chemical softeners) and mechanical (physical) methods.

Removing harness using chemical method involves the use of chemical water softeners. These are of two types: those which lead to precipitation; and those which do not precipitate.

A. Chemical Water Softeners which lead to precipitation - these are chemical substances added to the water to remove dissolved calcium, magnesium or iron(II) salt by forming precipitate or undissolved solids. The precipitate is then removed by filtration.

Examples of these chemicals are:

(i). Calcium hydroxide, $Ca(OH)_2$ - addition of calculated amount of $Ca(OH)_2$ will remove only temporary hardness from water. $Ca(OH)_2$ precipitates the insoluble trioxocarbonate(IV).

Example, $Ca(OH)_2(s) + Ca(HCO_3)_2(aq) \rightarrow 2CaCO_3(s) + 2H_2O$

Note: $Ca(OH)_2$ is slightly soluble; $Ca(HCO_3)_2$ is soluble; $CaCO_3$ is insoluble.

Also, notice that excess of $Ca(OH)_2$ could cause hardness, hence the amount added is measured.

(ii). Sodium hydroxide, NaOH - addition of caustic soda (NaOH) removes both temporary and permanent hardness by precipitating the metal ions which cause the hardness as insoluble hydroxides.

Example, $2NaOH(aq) + Ca(HCO_3)_2(aq) \rightarrow 2NaHCO_3(aq) + Ca(OH)_2(s)$

Note: $Ca(HCO_3)_2$ is soluble; $Ca(OH)_2$ is insoluble.

$2NaOH(aq) + MgSO_4(aq) \rightarrow Na_2SO_4(aq) + Mg(OH)_2(s)$

Note: $MgSO_4$ is soluble; is $Mg(OH)_2$ insoluble

(iii). Sodium trioxocarbonate(IV), Na_2CO_3 (in form of crystals (i.e. washing soda) and soda ash (anhydrous)) - addition of $Na_2CO_3.10H_2O$ (crystals) or Na_2CO_3 (anhydrous) will remove both temporary and permanent hardness.

Example, $Na_2CO_3(aq) + Ca(HCO_3)_2(aq) \rightarrow 2NaHCO_3(aq) + CaCO_3(s)$

$Na_2CO_3(aq) + CaSO_4(aq) \rightarrow Na_2SO_4(aq) + CaCO_3(s)$

(iv). Borax, $Na_2B_4O_7.\ 10H_2O$ - addition of borax removes both temporary and permanent hardness.

B. Chemical water softeners which do not lead to precipitation - these are chemical softeners whose process is based on the softeners ability to sequester Ca^{2+}, Mg^{2+} or Fe^{2+} (i.e. without precipitating them, but keep them in solution, away from precipitating soap). These substances are Mostly of the polyphosphate family, e.g., polymetaphosphate, $(NaPO_3)_n$ (this is sold under the trade name Calgon); and tetrasodium diphosphate, $Na_4P_2O_7$.

They remove both types of hardness. Mechanical Method Mechanical water softening include: A. Distillation method - this will remove all solid particles that had dissolved in the water, but it is a rather expensive method. Both temporary and permanent hardness are removed. B. Ion exchange method - this involves the use of porous solids ion exchangers.

The principle of this method is that, the ions, i.e. Ca^{2+}, Mg^{2+} or Fe^{2+}, which cause hardness are removed from water by exchanging them with other cations from the ion exchangers which do not cause hardness - by this, the water is free from hardness. This is a cation exchanger. Two major types of ion exchangers (also called permutit) are used in softening water.

These are:

1. The zeolites - these are naturally occurring aluminosilicate minerals, e.g., $NaAl(SiO_3)_2$ or $NaAlSi_2O_6$

2. The ion - exchange resins - these are synthetic organic polymers (e.g., polystyrene). For example, when water containing Ca^{2+} or Mg^{2+} ions is allowed to filter through thick layers of zeolite, the Na^+ ions in the zeolite are replaced by Ca^{2+} or Mg^{2+} ions in the solution: $2NaAlSi_2O_6 + Ca^{2+} \rightarrow Ca(AlSi_2O_6)_2 + 2Na^+$. The hardness is thus removed.

A zeolite which has been used can be regenerated by allowing it to stand in contact with conc. NaCl solution. The calcium alumino silicate is reconverted to sodium aluminosilicate: $Ca(AlSi_2O_6)_2 + 2Na^+ \rightarrow 2NaAlSi_2O_6 + Ca^{2+}$.

Hence, by this reaction, sodium zeolite is ready to serve as a water softener again - common salt (NaCl) will keep this ion exchange water softener operating for many years. Ion exchange resins are reacted with hot conc. H_2SO_4, and then neutralized with NaOH solution before being used to soften hard water. Note: mechanical water softening methods remove both temporary and permanent hardness from water.

Q. 2 Classify the GIT agent with example of each class and write in detail about saline cathartics?

Drugs Acting on the Gastrointestinal System

The Gastrointestinal (GI) Tract includes the mouth, stomach, small intestine (duodenum, jejunum, and ileum), large intestine (cecum and colon), rectum, anus, and its accompanying exocrine glands (the salivary glands, the pancreas, and the gallbladder).

- Drugs affecting the GI system are used in the treatment of Gastric Acidity, Peptic Ulcers, and Gastro Esophageal Reflux Disease (GERD), Bowel Motility Disorders (gastroparesis [delayed gastric emptying due to partial paralysis of the stomach muscles], constipation, and diarrhea), and for the treatment of nausea and vomiting.

- Gastric acid production

- Gastric acid is secreted from parietal cells when stimulated by the vagus nerve, histamine, and gastrin. CO_2 and H_2O react inside parietal cells, under the influence of carbonic anhydrase, to form bicarbonate HCO_3^- and H^+

Antacids are a class of medicines that neutralize acid in the stomach. They contain ingredients such as aluminum, calcium, magnesium, or sodium bicarbonate which act as bases (alkalis) to counteract stomach acid and make its pH more neutral.

pH is a measure of the concentration of hydrogen ions in a solution and this determines how acidic or how alkaline that solution is. The scale ranges from 1 to 14, where below 7 is acidic, 7 is neutral, and above 7 is alkaline. Normal gastric acid pH is in the range 1.5-3.5.

Antacids are used to relieve the symptoms of **Gastroesophageal Reflux Disease** (**GERD** also called **acid reflux**), **heartburn** or **indigestion** (also called **dyspepsia**). By neutralizing stomach acid, antacids relieve symptoms such as burning in the chest or throat area caused by acid **reflux**, a bitter taste in the mouth, a persistent dry cough, pain when lying down, and regurgitation.

Some antacids are also used for completely unrelated medical conditions, for example:

- Aluminum antacids: lower elevated blood phosphate levels and prevent the formation of **kidney stones**
- Calcium carbonate antacids: treat calcium deficiency
- Magnesium oxide antacids: treat magnesium deficiency.

The two main differences between antacids is the ingredients they contain and their formulation. The different ingredients - aluminum, calcium, magnesium, or sodium bicarbonate – all have differences in how long they take to start working, how long they keep working for, what other medications they may interact with, and who they are suitable for.

Antacids are available as liquids or tablets. Some products combine several antacid ingredients together or include alginates. Alginates are gum-like substances that float on top of the stomach contents, forming a raft that acts like a barrier. These may provide more symptom relief in people with reflux.

Antacids are medication that neutralize stomach acid to cut down on heartburn, sour stomach, acid indigestion, and stomach upset. Some antacids also contain simethicone, an ingredient that helps your body get rid of gas. Others have ingredients that can lead to diarrhea or constipation.

Antacids are the most commonly used product for treating heartburn discomfort. And because they start to work in seconds, they're also the fastest way to relieve your symptoms. Available without a prescription, antacids are available in convenient

chewable tablets or as a liquid. Most are relatively inexpensive, making antacids a popular product for fast relief.[1]

Antacids are the fastest acting heartburn relief available because they start to weaken the acid in your stomach the second they reach it. The weaker the acid in your stomach, the less likely it is to give you heartburn. The longer an antacid stays in the stomach, the longer it works. And having some food in your stomach may actually prolong an antacid's effect.[1]

Most antacids contain at least one of these key ingredients: calcium carbonate, magnesium hydroxide, aluminum hydroxide and/or sodium bicarbonate.

Calcium carbonate

Calcium carbonate is a strong and fast-acting antacid, and it's been used since the first century..

Antacids that contain calcium carbonate may work longer than those containing sodium bicarbonate or magnesium. The amount of calcium carbonate usually ranges between 500 and 1,000 milligrams per tablet. It's important to take calcium carbonate as directed and not exceed the recommendation on the label.[2] When used as directed, calcium carbonate is generally well tolerated.

Aluminum and magnesium

Aluminum salts dissolve slowly in the stomach, gradually relieving your heartburn symptoms; but they may cause constipation. Magnesium salts act quickly to neutralize acid, but are known to cause diarrhea.

You could say that two wrongs do make a right. Because the effects of aluminum and magnesium can balance each other out, using them together is often considered an effective treatment for digestive upset.

In recent years there have been questions about the long-term safety of taking aluminum, however. Because aluminum may deplete the body of phosphorus and calcium (increasing the risk of weak bones), some products are no longer using it.

Sodium bicarbonate

Sodium bicarbonate is frequently found in products like Alka-Seltzer®, baking soda, or as store brand sodium bicarbonate. It can work quickly to relieve heartburn symptoms, but it's also quickly eliminated from your stomach—so relief may not last as long.

Because it reacts with stomach acid and can produce a significant amount of carbon dioxide gas, sodium bicarbonate may cause people to belch or get flatulence when they use it.

Saline Cathartics:

Saline cathartics or purgatives are agents that quicken and increase evacuation from the bowl. Laxatives are mild cathartics. Cathartics are used: to ease defecation in patients with painful hemorrhoids or other rectal disorders and to avoid excessive straining and concurrent increase in abdominal pressure in patients with hernias Or to avoid potentially hazardous rise in B.P. during defecation in patients with hypertension, cerebral coronary or other arterial disease Or to relieve acute constipation Or to remove solid material from intestinal tract prior to certain roentgenographic studies. Laxative should only be used for short term therapy as prolonged use may lead to loss of spontaneous bowl rhythm upon which normal evacuation depends, causing patient to become dependent on

laxatives, the so called laxative effect. Constipation is the infrequent or difficult evacuation of the feces. It may be due to a person resisting the natural urge to defecate, causing the fecal material which remains in the colon to lose fluid and to become relatively dry and hard. Constipation can also be due to intestinal atony, intestinal spasm, emotions, drugs and diet. Many a time constipation can be helped by eating food such as natural laxatives or food with large roughages.

Four types of laxatives are known:

1. Stimulants
2. Bulk forming
3. Emollient
4. Saline cathartics

Compounds used as Saline cathartics:

(i)Sodium Acid Phosphate (sodium biphosphate) NaH 2 PO 4 2H 2 O M.W. = 156.01 I.P limit: It contains not less than 98.0% and not more than 100.5% of NaH 2 PO 4 calculated with reference to the dried substance.

Properties: Colorless, odorless, crystalline powder with saline acidic taste. Freely soluble in water and practically in soluble in alcohol. Slightly deliquescent.

Preparation:

1. It is prepared by adding phosphoric acid to hot concentrated solution of disodium phosphate until liquid ceases to give precipitate with barium chloride. The solution is then concentrated to the crystallization point.
2. By reaction with phosphoric acid with calculated quantity of sodium hydroxide.

Test for Identification:

For phosphate: To neutral sample solution add silver nitrate solution, a light yellow precipitate forms, the color of which is not changed by boiling and is readily soluble in 10M ammonia and dilute HNO 3 .

For sodium: To 2ml of solution add 2ml of 15% w/v of K 2 CO 3 heat to boil, no precipitate is produced. Add 3ml of potassium antimonite solution and heat to boil. Allow to cool in ice and if necessary scratch the inside of the test tube with glass rod white precipitate is produced.

(ii) Sodium Potassium Tartarate I.P limit: It contains not less than 99.0% and not more than 102% of C 4 H 4 KNa calculated on the anhydrous basis.

Preparation : It is prepared by boiling a solution of sodium carbonate and potassium bitartarate for sometime and allowing the reaction mixture to stand at 60°C. The solution is filtered, concentrated and crystallized.

Test for Identification:

For potassium: To 1ml of solution add 1ml dilute acetic acid and 1ml of 10% w/v sodium cobalt nitrite a yellow color produced.

For sodium: To 2ml of solution of 2ml of 15% w/v of K 2 CO 3 heat to boil, no precipitate is produced. Add 3ml of potassium antimonite solution and heat to boil. Allow to cool in ice and if necessary scratch the inside of the test tube with glass rod white precipitate is produced.

Assay: Weigh accurately 2g and heat until carbonized, cool and boil the residue with 50ml of water and 0.5N sulphuric acid (50ml). It is filtered washed with water and the filtrate and washing are titrated with 0.5N NaOH using methyl orange as indicator.
Each ml of 0.5M sodium hydroxide ≡ 0.07056g
Uses: It is used as laxative, food additive, as stabilizer in cheese and meet products.
(iii) Magnesium Sulphate I.P. limit: It contains not less than 99.0% and not more than 100.5% of magnesium sulphate calculated with reference to dried substance.
Properties: It forms colorless prismatic crystals. It dissolves in water, is practically insoluble in alcohol. It has cooling saline bitter taste.
Preparation: 1) It can be prepared by neutralizing hot dilute sulphuric acid with magnesium or its oxides or carbonate. The solution is filtered; the filtrate is concentrated and recrystallized. H2O 2) On commercial scale it is manufactured by reacting sulphuric with dolomite. Magnesium sulphate so formed is dissolved in the solution and the sparingly soluble calcium sulphate is deposited. The liquid is filtered the filtrate is concentrated and crystallized.
Test for Identification:
For magnesium: To solution of sample add dilute nitric acid solution a white precipitate is produced that is redissolved by adding 1ml of 2M ammonium chloride, add 0.25M disodium hydrogen phosphate a white crystalline precipitate is produced.
For sulphate: To 5ml of sample solution add 1ml of dilute HCl and 1ml barium chloride solution white precipitate. Add 1ml of iodine solution to the suspension, the suspension remains yellow (distinction from sulphites and dithionites) but decolorizes on adding stannous chloride (distinction from iodates).
Assay: Weigh accurately about 6.3gm of sample dissolve in 50ml of water, add 10ml of strong ammonia ammonium chloride solution and titrate with 0.05M disodium EDTA using 0.1gm of moderate black II mixture as indicator until blue color is obtained. Each ml of 0.05M disodium EDTA≡ 0.00602 gm of MgSO4
Uses: It is used as osmotic laxative, in treatment of electrolyte deficiency, in wet dressing in boils, in treatment of cholecystitis, sea sickness, hypertension etc.

Q. 3.Write preparation properties and uses of Calcium carbonate?

Calcium carbonate is one of the most popular chemicals which is first encountered in school classrooms, where the use of chalk (form of **$CaCO_3$**) is found. It is found in the earth's crust. It is also found in many forms such as marble, limestone, etc. Although they are available in various forms they are chemically similar and only differ physically. They are also referred to as calcite. It is a chemical compound with the formula **$CaCO_3$**.It is a white insoluble powder-like substance which occurs naturally in minerals, chalk, marble, limestone, calcite, shells, pearl, etc. Medicinally, it is used as an antacid or as a calcium supplement. It is also used as fillers in cosmetics. It is added to swimming pools as a disinfectant agent and as pH corrector. It finds extensive usage in the manufacturing industry as a building material (marble), ingredient for quick lime and cement.

Preparation:

On the large scale, it is prepared by passing carbon dioxide gas through calcium hydroxide (slaked lime). However, if carbon dioxide is passed in excess, it forms the

soluble calcium hydrogen-carbonate.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

At 1200K, calcium carbonate decomposes to give carbon dioxide and calcium oxide.

$CaCO_3 \rightarrow CaO + CO_2$

On reacting with dilute acids, calcium carbonate gives carbon dioxide.

$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

$CaCO_3$ is obtained by using carbon dioxide and slaked lime as raw materials. When carbon dioxide is passed through slaked lime, calcite is obtained. Another method to obtain calcite is by adding sodium carbonate to calcium chloride.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$

When carbon dioxide is passed in excess it leads to the formation of calcium hydrogen-carbonate.

Properties of $CaCO_3$

- It is a fluffy powder.
- It has low solubility in water.
- It decomposes to give carbon dioxide when heated up to 1200K.
- When it reacts with a dilute acid, it liberates carbon dioxide as a by-product.

  $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

Uses of calcium carbonate

- It plays an important role in construction, be it as a building material (marble) or as an ingredient in cement.
- It is used in medicinal industries which manufacture antacids, tablets which are made of base materials etc.
- It is used as calcium supplements.
- It is used in the manufacture of paints, paper, plastics, etc.

Q. 4. Explain in brief about Acidifying Agents?

Acidifiers are the inorganic chemicals that either produce or become acid. These are the drugs which are able to increase the acidity, in GIT. Thus decreasing the stomach pH. Some of these drugs are used to increase metabolic acidosis whereas some of these are used to increase the gastric hydrochloric acid.

These are many types of acidifiers but the main four main types are:

1. **Gastric acidifiers:**

These are the drugs which are used to restore temporarily the acidity of the stomach in patients suffering from achlorhydria or hypochlorhydria.

2. **Urinary acidifiers:**

These are the drug which is used to render acidic urine to enable treatment of some types of urinary tract disorders.

3. **Systemic acidifiers:**

These are the drugs which are able to neutralize the alkaline body fluid, particularly blood, in patients who are suffering from systemic alkalosis.

4. **Acids:**

Acids are used as pharmaceutical aids in the preparation, laboratory quality control [1].

Acidifiers in Poultry:

Organic acids have multi usages in poultry feeds as they help in preservation to control microbial growth, reduction of feed buffer capacity, inhibition of pathogenic bacteria and betterment of nutrient digestibility. This low pH also curbs pathogens. We provide supracid dry acidifier which ensures the growth of animal. The major purpose of using this acidifier is to improve growth performance and better the profitability in poultry production.

Effects on Nutrient Digestion:

· Improves the digestion, absorption and utilization of feed.
· Stimulates the activation of digestive enzymes.

Advantages:

· Less corrosive
· Completely bio – degradable
· Less stringent smell of acids
· No resistance
· User – friendly
· No withdrawal time.

Acidifiers in Animal Nutrition:

Organic acids have multi usage in animal feeds. Organic acids may act as energy sources and help to reduce the tissue wastage .lowering the dietary buffering capacity has been related to beneficial effects on digestion. The effects of organic acid sin the intestinal tract are two- fold. They reduce pH in the stomach and small intestine. Organic acids stimulated intermediary metabolism, resulting in improved energy or protein/ amino acid utilization.

Uses:

· Organic acids and salts promote performance and health in animals
· Possibilities of E. coil control by using acidifier in livestock production
· Possibilities of salmonella control with the aid of acidifiers
· Acidifiers used in poultry diet and poultry production
· The use of different dosages of acidifiers based on in organic acids in post – weaning piglets
· Acidifiers are used antibacterial agent such as formic acid, acetic acid, lactic acid etc.
· Dilute HCL is used as acidifying agent [2].

The pH of stomach is 1.5 -2 when empty and rises to pH 5-6 when food is ingested. The pH of stomach is so low because of the secretion of HCl. Gastric HCl act by destroying the bacteria in the ingested food and drinks. It softens the fibrous food and promotes the formation of the proteolytic enzyme pepsin. This enzyme is formed from pepsinogen at acidic pH (>6). Pepsin helps in the metabolism of proteins in the ingested food. Therefore lack of HCl in the stomach can cause Achlorhydria.

Two types of achlorhydria are known:

1) where the gastric secretion is devoid of HCl, even after stimulation with histamine phosphate
2) 2) where gastric secretion is devoid of HCl, but secreted upon stimulation with histamine phosphate.

The cause of achlorhydria in first case may be subtotal gastrectomy, atrophic gastritis, carcinoma, gastric polyp etc while in later case it may be chronic nephritis, tuberculosis, hyperthyroidism, chronic alcoholism, sprue, pellagra etc. The symptoms vary with associated disease but they generally include mild diarrhea or frequent bowl movement, epigastric pain and sensitivity to spicy food. Achlorhydria can be treated by various acidifying agents like ammonium chloride, dilute HCl, Calcium chloride etc.

Dilute Hydrochloric Acid HCl M.W 36.5

I.P. Limit: It contains not less than 9.5% and not more than 10.5% w/w of HCl. The acid should be diluted with 25-50 volumes with water or juice and sipped through a glass tube to prevent reaction upon dental enamel. It is taken during or after meals given in conjunction with iron therapy in hyper chromic anemia. Preparation: It is prepared by mixing 274gm of HCl and 726 gm of purified water.

Test for Identification:

1) When added to KMnO4 with dilute nitric acid, chlorine is evolved.

2) To acidified solution add silver nitrate solution, shake and allow to stand, curdy white precipitate is formed, which is insoluble in HNO3 but soluble after being washed with water in ammonium hydroxide from which it is reprecipitated by the addition of HNO 3 .

Assay: Weigh accurately 6gm, add 30 ml of distilled water mix and titrate with 1N NaOH using methyl red as indicator. Each ml of 1N NaOH is equivalent to 0.03646gm of HCl.

Q. 5. Write preparation properties and uses of Ferrous Sulfate?

Ferrous sulfate is an iron salt popularly known as **green vitriol**. Imferon and iron dextran are injectable iron. Ferrous fumarate, ferrous gluconate, and ferrous sulfate are generic names for oral iron. Ferrous sulfate is by far the best and cheapest for iron supplement. It is formed when iron filings are mixed into a solution of copper sulfate, iron pushes the copper since it is more reactive and takes its place resulting in the formation of iron sulfate.

Other names – Iron(II) sulfate, Iron sulfate, Iron(2+) sulfate

$FeSO_4$	Ferrous Sulfate
Density	2.84 g/cm³
Molecular Weight/ Molar Mass	151.908 g/mol
Boiling Point	>300 °C
Melting Point	56-64 °C
Chemical Formula	$FeSO_4$

Physical Properties of Ferrous Sulfate – $FeSO_4$

Odour	Odourless
Appearance	Blue-green powder or crystals
Covalently-Bonded Unit	2
Complexity	62.2
Hydrogen Bond Acceptor	4
Solubility	Soluble in water.

Chemical Properties of Ferrous Sulfate – $FeSO_4$

Ferrous sulfate reacts with aluminium under displacement reaction forming aluminium sulfate and metallic iron. The chemical reaction is given below.

$$2Al + 3FeSO_4 \rightarrow Al_2(SO_4)_3 + 3Fe$$

Ferrous sulfate reacts with potassium permanganate in the presence of sulfuric acid forms ferric sulfate, manganese sulfate, potassium sulfate and water.

$$10FeSO_4 + 2KMnO_4 + 8H_2SO_4 \rightarrow 5Fe_2(SO_4)_3 + 2MnSO_4 + 8H_2O + K_2SO_4$$

Upon dissolving in water, ferrous sulfates form the metal aquo complex $[Fe(H_2O)_6]^{2+}$, which is an almost colorless, paramagnetic ion.

On heating, iron(II) sulfate first loses its water of crystallization and the original green crystals are converted into a brown colored anhydrous solid. When further heated, the anhydrous material releases sulfur dioxide and white fumes of sulfur trioxide, leaving a reddish-brown iron(III) oxide. Decomposition of iron(II) sulfate begins at about 680 °C (1,256 °F).

$$2\ FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$$

Like all iron(II) salts, iron(II) sulfate is a reducing agent. For example, it reduces nitric acid to nitrogen monoxide and chlorine to chloride:

$$6\ FeSO_4 + 3\ H_2SO_4 + 2\ HNO_3 \rightarrow 3\ Fe_2(SO_4)_3 + 4\ H_2O + 2\ NO$$

$$6\ FeSO_4 + 3\ Cl_2 \rightarrow 2\ Fe_2(SO_4)_3 + 2\ FeCl_3$$

Upon exposure to air, it oxidizes to form a corrosive brown-yellow coating of "basic ferric sulfate", which is an adduct of iron(III) oxide and iron(III) sulfate:

$$12\ FeSO_4 + 3\ O_2 \rightarrow 4\ Fe_2(SO_4)_3 + 2\ Fe_2O_3$$

Uses of Ferrous Sulfate – $FeSO_4$

- Used as iron supplements are indicated in patients with diseases caused by iron deficiency.
- Used in the treatment of iron deficiency anemia, prophylaxis for iron deficiency in pregnancy.

- Used in precaution if sedation or general anesthesia is required; risk of hypotensive episode.
- Ferrous sulfate can also be used with chlorine. This treatment is normally known as chlorinated copperas treatment.

Q.6. Explain in detail about Limit test of Arsenic?

Definition of Limit Tests

Limit = a value or amount that is likely to be present in a substance
Test = to examine or to investigate
Impurities = a foreign matter present in a compound

Limit test is defined as quantitative or semi quantitative test designed to identify and control small quantities of impurity which is likely to be present in the substance.

Limit test is generally carried out to determine the inorganic impurities present in compound. In short, limit test is nothing but to identify the impurities present in the substance and compare it with standard.

Importance of Limit tests:

To find out the harmful amount of impurities
To find out the avoidable/unavoidable amount of impurities
In Chemistry, Limit means a value or amount that is likely to be present in a substance and test means to examine or to investigate. Thus, limit test is nothing but to identify the impurities in the substance and compare it with standard. In general, limit test is defined as quantitative or semiquantitative test designed to identify and control small quantities of impurity which is likely to be present in the substance. Limit test is generally carried out to determine the inorganic impurities present in compound.

Limit test of chloride is based on the reaction of soluble chloride with silver nitrate in presence of dilute nitric acid to form silver chloride, which appears as solid particles (Opalescence) in the solution.

Limit test of sulphate is based on the reaction of soluble sulphate with barium chloride in presence of alcohol and potassium sulphate to form barium sulphate, which appears as solid particles (turbidity) in the solution. Here alcohol is added to prevent super saturation.

Limit test of heavy metals is based on the reaction of metallic impurities with hydrogen sulfide in acidic medium to form colored solution. Metals that response to this test are lead, mercury, bismuth, arsenic, antimony, tin, cadmium, silver, copper, and molybdenum.
Limit test of lead is based on the reaction of lead and diphenyl thiocabazone (dithizone) in alkaline solution to form lead dithizone complex which is read in color.

Limit test of Iron is based on the reaction of iron in ammonical solution with thioglycollic acid to form iron thioglycolate which is pink-reddish purple in color.

Limit test of Arsenic

Principle:

Limit test of Arsenic is based on the reaction of arsenic gas with hydrogen ion to form yellow stain on mercuric chloride paper in presence of reducing agents like potassium iodide. It is also called as Gutzeit test and requires special apparatus.

Arsenic, present as arsenic acid in the sample is reduced to arsenious acid by reducing agents like potassium iodide, stannous acid, zinc, hydrochloric acid, etc. Arsenious acid is further reduced to arsine (gas) by hydrogen and reacts with mercuric chloride paper to give a yellow stain.

$H_3AsO_4 + H_2SnO_2 \rightarrow H_3AsO_3 + H_2SnO_3$

Arsenic acid Arsenious acid

$H_3AsO_3 + 3H_2 \rightarrow AsH_3 + 3H_2O$

Arsenious acid Arsine

The depth of yellow stain on mercuric chloride paper will depend upon the quality of arsenic present in the sample.

Procedure:

Test solution:

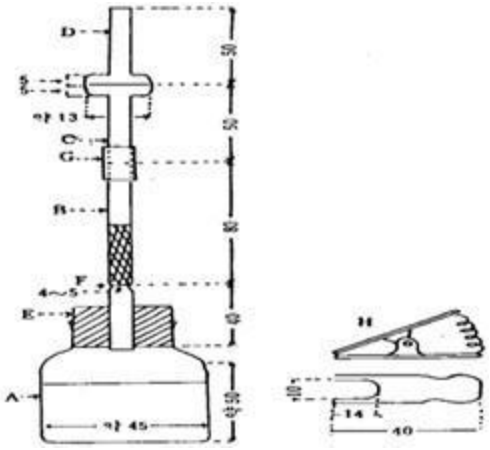
The test solution is prepared by dissolving specific amount in water and stannated HCl (arsenic free) and kept in a wide mouthed bottle.

To this solution 1 gm of KI, 5 ml of stannous chloride acid solution and 10 gm of zinc is added (all this reagents must be arsenic free)

Keep the solution aside for 40 min and stain obtained on mercuric chloride paper is compared with standard solution.

Standard solution:

A known quantity of dilute arsenic solution is kept in wide mouthed bottle and rest procedure is followed as described in test solution.



A : approximately 60 ml generator bottle with 40 ml indicating line.

B : glass tube with 6.5 mm inner diameter

C and D : a ground joint glass tube with 6.5 mm inner diameter and 18 mm outer diameter at the joint. Inner joint and the outer joint form a concentric circle.

E : rubber stopper

F : narrow part of the glass tube B. Glass wool is inserted up to this part.

G : rubber board (Lead acetate cotton plug)

H : clamp

Reasons:

Stannous chloride is used for complete evolution of arsine

Zinc, potassium iodide and stannous chloride is used as a reducing aget

Hydrochlorid acid is used to make the solution acidic

Lead acetate pledger or papers are used to trap any hydrogen sulphide which may be evolved along with arsine.

Apparatus:

A suitable type of apparatus is described below, though other acceptable constructions are available. A wide-mouthed bottle of about 120 mL capacity, is fitted with a rubber bung through which passes a glass tube. The latter, made from ordinary glass tubing, has a total length of 200 mm and an internal diameter of exactly 6.5 mm (external diameter about 8 mm), is drawn out at one end to a diameter of about 1 mm, and has a hole not less than 2 mm in diameter blown in the side of the tube, near the constricted part. The tube is passed through the bung fitting the bottle so that, when inserted in the bottle containing 70 mL of liquid, the constricted end of the tube is above the surface of the liquid and the hole in the side is below the bottom of the bung. The upper end of the tube is cut off square, and is either slightly rounded off or ground smooth. Two rubber bungs (about 25 mm × 25 mm), each with a hole bored centrally and true and exactly 6.5 mm in diameter, are fitted with a rubber band or spring clip for holding them tightly together. Alternatively, the two bungs may be replaced by any suitable construction satisfying the conditions of the test, as described below.

Procedure:

Pack the glass tube lightly with cotton-wool, previously moistened with lead acetate (80 g/l) TS and dried, so that the upper surface of the cotton-wool is not less than 25 mm below the top of the tube. Insert the upper end of the tube into the narrow end of one of the pair of rubber bungs, either (1) to a depth of about 10 mm in the case of the tube with the rounded-off end or (2) so that the ground end of the tube is flush with the larger end of the bung. Place a piece of mercuric bromide paper AsR flat on the top of the bung, and place the other bung over it. Secure the assembly by means of a rubber band or spring clip, in such a manner that the borings of the two bungs (or the boring of the upper bung and the glass tube) meet to form a true tube 6.5 mm in diameter interrupted by a diaphragm of mercuric bromide paper AsR. Instead of this method of attaching the mercuric bromide paper AsR, any other method may be used provided (1) that the whole of the evolved gas passes through the paper, (2) that the portion of the paper in contact with the gas is a circle 6.5 mm in diameter, and (3) that the paper is protected from sunlight during the test. Place the solution, prepared as specified in the monograph, in the wide-mouthed bottle, add 1 g of potassium iodide AsR and 10 g of granulated zinc AsR, and place the prepared glass tube assembly quickly into position. Allow the reaction to proceed for 40 minutes. Compare any yellow stain that is produced on the mercuric bromide paper AsR, with a standard stain, produced in a similar manner with a known quantity of dilute arsenic AsTS. Make the comparison in daylight and immediately after simultaneous preparation of the test and standard stains; the stains fade on keeping. The most suitable temperature for carrying out the test is generally about 40°C but, as the rate of evolution of the gas varies somewhat with different batches of granulated zinc AsR, the temperature may be adjusted to obtain a regular, but not too violent, evolution of gas. The reaction may be accelerated by placing the apparatus on a warm surface, care being taken to ensure that the mercuric bromide paper AsR remains quite dry throughout the test. Between successive tests, the tube must be washed with hydrochloric acid (~250 g/l) AsTS, rinsed with water, and dried.

Q. 7. Write a note on Limit Test of Iron

Definition of Limit Tests

Limit = a value or amount that is likely to be present in a substance
Test = to examine or to investigate
Impurities = a foreign matter present in a compound

Limit test is defined as quantitative or semi quantitative test designed to identify and control small quantities of impurity which is likely to be present in the substance.

Limit test is generally carried out to determine the inorganic impurities present in compound. In short, limit test is nothing but to identify the impurities present in the substance and compare it with standard.

Importance of Limit tests:

To find out the harmful amount of impurities

To find out the avoidable/unavoidable amount of impurities

In Chemistry, Limit means a value or amount that is likely to be present in a substance and test means to examine or to investigate. Thus, limit test is nothing but to identify the impurities in the substance and compare it with standard. In general, limit test is defined as quantitative or semiquantitative test designed to identify and control small quantities of impurity which is likely to be present in the substance. Limit test is generally carried out to determine the inorganic impurities present in compound.

Limit test of chloride is based on the reaction of soluble chloride with silver nitrate in presence of dilute nitric acid to form silver chloride, which appears as solid particles (Opalescence) in the solution.

Limit test of sulphate is based on the reaction of soluble sulphate with barium chloride in presence of alcohol and potassium sulphate to form barium sulphate, which appears as solid particles (turbidity) in the solution. Here alcohol is added to prevent super saturation.

Limit test of heavy metals is based on the reaction of metallic impurities with hydrogen sulfide in acidic medium to form colored solution. Metals that response to this test are lead, mercury, bismuth, arsenic, antimony, tin, cadmium, silver, copper, and molybdenum.

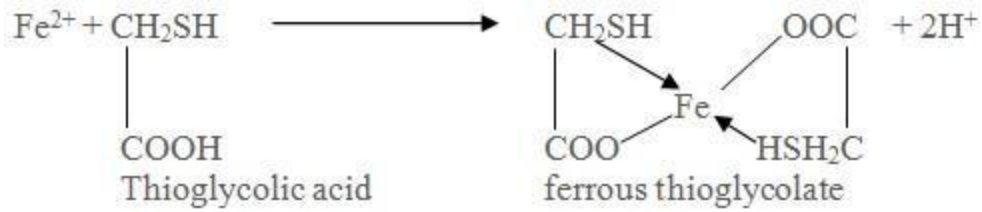
Limit test of lead is based on the reaction of lead and diphenyl thiocabazone (dithizone) in alkaline solution to form lead dithizone complex which is read in color.

Limit test of Iron is based on the reaction of iron in ammonical solution with thioglycollic acid to form iron thioglycolate which is pink-reddish purple in color.

Limit Test of Iron

Principle:

Limit test of Iron is based on the reaction of iron in ammonical solution with thioglycollic acid in presence of citric acid to form iron thioglycolate which is pale pink to deep reddish purple in color.



This test is based on the reaction of thioglycolic acid with iron in the given sample. A purple colored ferrous thioglycolate salt is formed. The color intensity is compared with that of a standard substance containing iron.

2HSCH2CO2H + Fe+ ————————> Fe [HSCH2COO]2 + 2H+
Thioglycolic acid Ferrous thioglycollate

The procedure of limit test for iron:

Test solution

1. Take the given sample into a Nessler's cylinder and label it as "Test."Dissolve it in 40ml of distilled water. Then add 2ml of 20% iron free citric acid solution.
2. Now add 0.1ml of thioglycolic acid and make the entire solution alkaline using iron free ammonia solution.
3. Dilute to 5oml mark with distilled water and stir the solution. Let the solution stand for 5 minutes.
4. Compare the color produced with that of the standard solution.

Standard solution

1. Place 2ml of the standard iron solution in another Nessler's cylinder labeled as "standard."
2. Now add 40ml of distilled and 2ml of 20% iron free citric acid.
3. Add 0.1ml of thioglycolic acid and convert the entire solution to alkaline pH by adding iron free ammonia solution.
4. Makeup to 50ml mark with distilled water, stir the solution with a glass rod and allow to stand for 5minutes.

Compare the colors produced in both the test and standard Nessler's cylinders by viewing vertically downwards.

Note:

Citric acid is used to prevent precipitation of iron in the presence of ammonia. Citric acid forms a soluble complex with iron. Hence, iron stays as free ions in the presence of ammonia.

Distilled water should be used for dilution. Tap water cannot be used as it can have iron impurities leading to errors in measurement.

The iron impurity can be present in both ferrous (Fe2+) and ferric (Fe3+) form and thy0glycollic acid convert the ferric form into ferrous form.

It then reacts with a ferrous form to form a colored complex in alkaline media.

Result inference: If the color intensity of the test is less than standard the sample passes the limit test for iron.

Q. 8. Write physiological role of sodium and chloride?

Chemically, electrolytes are substances that become ions in solution and acquire the capacity to conduct electricity. Electrolytes are present in the human body, and the balance of the electrolytes in our bodies is essential for normal function of our cells and our organs. Body fluid contains electrolytes, chemicals which, when they dissolve in water, produce charged ions. These ions enable the flow of electrical signals through the body. Electrolytes play an important role in the body; they regulate the osmotic pressure in cells and help maintain the function of muscle and nerve cells. If electrolyte levels are too low or too high, cell and organ functions will decline, which could lead to life-threatening conditions.

The main electrolytes include sodium, chloride, potassium, calcium and magnesium. These five nutritional elements are minerals, and when minerals dissolve in water they separate into positive and negative ions. For example, when sodium chloride (NaCl) is dissolved in water, it separates into positive sodium ions and negative chloride ions.

Common electrolytes that are measured by doctors with blood testing include sodium, potassium, chloride, and bicarbonate. The functions and normal range values for these electrolytes are described below.

Sodium:

Sodium is the major positive ion (cation) in fluid outside of cells. The chemical notation for sodium is Na+. When combined with chloride, the resulting substance is table salt. Excess sodium (such as that obtained from dietary sources) is excreted in the urine. Sodium regulates the total amount of water in the body and the transmission of sodium into and out of individual cells also plays a role in critical body functions. Many processes in the body, especially in the brain, nervous system, and muscles, require electrical signals for communication. The movement of sodium is critical in the generation of these electrical signals. Therefore, too much or too little sodium can cause cells to malfunction, and extremes in the blood sodium levels (too much or too little) can be fatal.

- Increased sodium (hypernatremia) in the blood occurs whenever there is excess sodium in relation to water. There are numerous causes of hypernatremia; these may include kidney disease, too little water intake, and loss of water due to diarrheaand/or vomiting.
- A decreased concentration of sodium (hyponatremia) occurs whenever there is a relative increase in the amount of body water relative to sodium. This happens with some diseases of the liver and kidney, in patients with congestive heart failure, in burn victims, and in numerous other conditions.

A Normal blood sodium level is 135 - 145 milliEquivalents/liter (mEq/L), or in international units, 135 - 145 millimoles/liter (mmol/L).

Sodium is the major cation of the extracellular fluid. It is responsible for one-half of the osmotic pressure gradient that exists between the interior of cells and their surrounding environment. People eating a typical Western diet, which is very high in NaCl, routinely take in 130 to 160 mmol/day of sodium, but humans require only 1 to 2 mmol/day. This excess sodium appears to be a major factor in hypertension (high blood pressure) in some people. Excretion of sodium is accomplished primarily by the kidneys. Sodium is freely filtered through the glomerular capillaries of the kidneys, and although much of the filtered sodium is reabsorbed in the proximal convoluted tubule, some remains in the filtrate and urine, and is normally excreted.

Hyponatremia is a lower-than-normal concentration of sodium, usually associated with excess water accumulation in the body, which dilutes the sodium. An absolute loss of sodium may be due to a decreased intake of the ion coupled with its continual excretion in the urine. An abnormal loss of sodium from the body can result from several

conditions, including excessive sweating, vomiting, or diarrhea; the use of diuretics; excessive production of urine, which can occur in diabetes; and acidosis, either metabolic acidosis or diabetic ketoacidosis.

A relative decrease in blood sodium can occur because of an imbalance of sodium in one of the body's other fluid compartments, like IF, or from a dilution of sodium due to water retention related to edema or congestive heart failure. At the cellular level, hyponatremia results in increased entry of water into cells by osmosis, because the concentration of solutes within the cell exceeds the concentration of solutes in the now-diluted ECF. The excess water causes swelling of the cells; the swelling of red blood cells—decreasing their oxygen-carrying efficiency and making them potentially too large to fit through capillaries—along with the swelling of neurons in the brain can result in brain damage or even death.

Hypernatremia is an abnormal increase of blood sodium. It can result from water loss from the blood, resulting in the hemoconcentration of all blood constituents. Hormonal imbalances involving ADH and aldosterone may also result in higher-than-normal sodium values.

Potassium:

Potassium is the major positive ion (cation) found inside of cells. The chemical notation for potassium is K+. The proper level of potassium is essential for normal cell function. Among the many functions of potassium in the body are regulation of the heartbeat and the function of the muscles. A seriously abnormal increase in potassium (hyperkalemia) or decrease in potassium (hypokalemia) can profoundly affect the nervous system and increases the chance of irregular heartbeats (arrhythmias), which, when extreme, can be fatal.

- Increased potassium is known as hyperkalemia. Potassium is normally excreted by the kidneys, so disorders that decrease the function of the kidneys can result in hyperkalemia. Certain medications may also predispose an individual to hyperkalemia.
- Hypokalemia, or decreased potassium, can arise due to kidney diseases; excessive losses due to heavy sweating, vomiting, diarrhea, eating disorders, certain medications, or other causes.

The normal blood potassium level is 3.5 - 5.0 milliEquivalents/liter (mEq/L), or in international units, 3.5 - 5.0 millimoles/liter (mmol/L).

Chloride:

Chloride is the major anion (negatively charged ion) found in the fluid outside of cells and in the blood. An anion is the negatively charged part of certain substances such as table salt (sodium chloride or NaCl) when dissolved in liquid. Chloride plays a role in helping the body maintain a normal balance of fluids.

The balance of chloride ion (Cl-) is closely regulated by the body. Significant increases or decreases in chloride can have deleterious or even fatal consequences:

- Increased chloride (hyperchloremia): Elevations in chloride may be seen in diarrhea, certain kidney diseases, and sometimes in overactivity of the parathyroid glands.

- Decreased chloride (hypochloremia): Chloride is normally lost in the urine, sweat, and stomach secretions. Excessive loss can occur from heavy sweating, vomiting, and adrenal gland and kidney disease.

The normal serum range for chloride is 98 - 108 mmol/L.

Chloride is the predominant extracellular anion. Chloride is a major contributor to the osmotic pressure gradient between the ICF and ECF, and plays an important role in maintaining proper hydration. Chloride functions to balance cations in the ECF, maintaining the electrical neutrality of this fluid. The paths of secretion and reabsorption of chloride ions in the renal system follow the paths of sodium ions.

Hypochloremia, or lower-than-normal blood chloride levels, can occur because of defective renal tubular absorption. Vomiting, diarrhea, and metabolic acidosis can also lead to hypochloremia.

Hyperchloremia, or higher-than-normal blood chloride levels, can occur due to dehydration, excessive intake of dietary salt (NaCl) or swallowing of sea water, aspirin intoxication, congestive heart failure, and the hereditary, chronic lung disease, cystic fibrosis. In people who have cystic fibrosis, chloride levels in sweat are two to five times those of normal levels, and analysis of sweat is often used in the diagnosis of the disease.

Q. 9. What are topical Agent and discuss the mechanism of topical antimicrobial agent?

Discuss uses, assay and properties of zinc oxide and Hydrogen peroxide?

Antimicrobial agent: A general term for drugs, chemicals, or other substances that either kill or slow the growth of microbes. Among the antimicrobial agents are antibacterial drugs, antiviral agents, antifungal agents, and antiparasitic drugs.

TOPICAL AGENTS: Topical means pertaining to a particular locality or place or simply it means “local”. Therefore the drugs dealt with in this chapter may be substances which are applied directly on the skin or muconus membrane or any other surface.

PROTECTIVE AND ADSORBENTS

Protective and adsorbents are drugs which adsorb intestinal toxins, bacteria etc, and give a protective coating to the inflamed mucosal walls.

Storage: Store in well closed containers. Medicinal and Pharmaceutical Uses: Adsorbent. Charcoal is of great value in the purification of chemicals and the adsorption of gases.

BISMUTH SUBCARBONATE: Bismuth subcarbonate is also known as bismuth carbonate. It is a basic salt of variable composition.

Preparation: for preparing bismuth subcarbonate an acid solution of bismuth nitrate is added with constant stirring to a warm solution to a warm solution of sodium carbonate. The precipitated bismuth subcarbonate is washed with a small quantity of cold water to remove the nitrate and dried at a temperature below 60 C. the precipitate should not be

washed repeatedly with water as the subcarbonate will be decomposed and bismuth hydroxide will be formed.

$4Bi(NO3)3 + 6Na2CO3 + H2O = [(BiO)2CO3]2.H2O + 12Na2CO3 + 4CO2$

Bismuth subcarbonate The bismuth nitrate itself may be prepared by dissolving metallic bismuth in 50 % nitric acid. The solution is evaporated to a low volume.

$2Bi + 8HNO3 = 2Bi(NO3)3 + 2NO + 4H20$

Assay: It is assayed by complexometeric method. It is dissolved in nitric acid, diluted with water and titrated with 0.1M disodium edetate using xylenol orange as indicator. The colour change at the end point is from pinkish violet to lemon yellow.

ZINC OXIDE,ZnO

Preparation

1. Zinc oxide is prepared on a large scale by burning zinc metal in a current of air.

$Zn + O2 = 2ZnO$

2. In this method,

Zinc carbonate is prepared first by reacting zinc sulphate with a boiling solution of sodium carbonate. The precipitated basic carbonate of zinc is collected, washed to remove sulphate, dried and finally gently ignited. It loses carbon dioxide and water, leaving zinc oxide as the residue

$2ZnCO3,2Zn(OH)2= 4ZnO + 2CO2 + 2H2O$

Assay:

The sample is dissolved in 2M acetic acid and diluted with water. Xylenol orange titrurate and sufficient hexamine to produce violet pink colour are added. A further quantity of hexamine is added and titrated with 0.1M disodium edetate until the solution becomes yellow. In this complexometric titration hexamine is added to raise the pH to the alkaline side and the zinc oxide converted to zinc acetate by dissolving in acetic acid and titrated with 0.1M disodium edetate using xylenol orange as indicator. Zinc is complexed by the disodium edetate and the indicator changes colour from violet-pink to yellow at the end point.

Storage: Since it absorbs carbon dioxide from the air, store it in a well closed container. Medicinal

Use: Astrigent and topical protective. Zonic oxide is a mild antiseptic and astringent. In the form of zinc oxide ointment or dusting powder, it is used in the treatment of eczema, ringworm, pruritus and psoriasis. It is also widely used in the manufacture of plasters.

HYDROGEN PEROXIDE, H_2O_2

Hydrogen peroxide (H_2O_2) was discovered by French chemist Thenard.

Preparation : It is prepared by (i) Laboratory method : In laboratory, H_2O_2 is prepared by Merck's process. It is prepared by adding calculated amounts of sodium peroxide to ice cold dilute (20%) solution of H_2SO_4.

$Na_2O_2 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O_2$

(ii) By the action of sulphuric acid or phosphoric acid on hydrated barium peroxide $BaO_2.8H_2O$ (a)

$BaO_2.8H_2O + H_2SO_4 \rightarrow BaSO_4 \downarrow + H_2O_2 + 8H_2O$

It must be noted that anhydrous barium peroxide does not react readily with sulphuric acid (because a coating of insoluble barium sulphate is formed on its surface which stops further action of the acid). Therefore, hydrated barium peroxide, $BaO_2.8H_2O$ must be used.

(b) $3BaO_2 + 2H_3PO_4 \rightarrow Ba_3(PO_4)_2 + 3H_2O_2$ $Ba_3(PO_4)_2 + 3H_2SO_4 \rightarrow 3BaSO_4 + 2H_3PO_4$

Phosphoric acid is preferred to H_2SO_4 because soluble impurities like barium persulphate (from $BaO_2.8H_2O + H_2SO_4$) tends to decompose H_2O_2 while H_3PO_4 acts as preservative (negative catalyst) for H_2O_2.

(iii) Industrial method: On a commercial scale, H_2O_2 can be prepared by the electrolysis of 50% H_2SO_4 solution. In a cell, peroxy disulphuric acid is formed at the anode.

$2H_2SO_4 \longrightarrow H_2S_2O_8 (aq.) + H_2$

Electrolysis Peroxy disulphuric acid This is drawn off from the cell and hydrolysed with water to give H_2O_2.

$H_2S_2O_8 + 2H_2O \longrightarrow 2H_2SO_4 + H_2O_2$

The resulting solution is distilled under reduced pressure when H_2O_2 gets distilled while $H_2SO_4$with high boiling point, remains undistilled.

Assay:

It is acidified with dilute sulphuric acid and titrated against N/10 potassium permanganate.

2KMnO4 + 3H2SO4 + 5H2O2 = K2SO4 + MnSO4 + 8H2O + 5O2 (OR) O +H2O2 = H20 +O2

Storage:

H2O2 is not stored in glass bottles since the alkali metal oxides present in glass catalyse its decomposition. It is, therefore, stored in paraffin wax coated glass, plastic or teflon bottles. Small amounts of acid, glycerol, alcohol, acetanilide and H3PO4are often used as stablizers to check its decomposition.

Uses:

(i) For bleaching delicate articles like wool, hair, feather, ivory, etc.
(ii) For restoring colour of old lead paintings whose white lead has blackened due to formation of PbS by H2S of atmosphere. Hydrogen peroxide converts the black lead sulphide to white lead sulphate
(iii) As an aerating agent in production of spong rubber.
(iv) As an antiseptic and germicide for washing wounds, teeth and ears, under the name of perhydrol.
(v) In the manufacture of sodium perborate, sodium percarbonate. These are used in high quality detergents.
(vi) As an antichlor.
(vii) As an oxidant for rocket fuel.
(viii) In the detection of Ti, V and Cr ions with which it forms peroxides of characteristics colours.
(ix) In the production of epoxides, propylene oxide and polyurethanes.
(x) In the synthesis of hydroquinone, pharmaceuticals (cephalosoporin) and food products like tartaric acid.

Q.10.What is Expectorants?

Expectorants are drugs that loosen and clear mucus and phlegm from the respiratory tract. There are two drugs that are routinely used to clear mucus from the respiratory tract: guaifenesin and acetylcysteine. Guaifenesin may be taken by mouth and is an ingredient in many over-the-counter cough and cold remedies. Although acetylcysteine is by far the more reliable of the two, it must be administered with special inhalation equipment or instilled directly into the trachea.

Other drugs have been used as expectorants, but lack evidence of either efficacy or safety or both:

- ammonium chloride
- bromhexine
- ipecacuanha
- potassium iodide
- wild cherry syrup

Asthma —A disease in which the air passages of the lungs become inflamed and narrowed, causing wheezing, coughing, and shortness of breath.

Bronchitis —Inflammation of the air passages of the lungs.

Chronic —Refers to a disease or condition that progresses slowly but persists or recurs over time.
Cough suppressant —A medication that stops or prevents coughing.
Emphysema —A chronic respiratory disease that involves the destruction of air sac walls to form abnormally large air sacs that have reduced gas exchange ability and that tend to retain air within the lungs. Symptoms include labored breathing, the inability to forcefully blow air out of the lungs, and an increased susceptibility to respiratory tract infections. Emphysema is usually caused by smoking.
Mucus —The thick fluid produced by the mucous membranes that line many body cavities and structures. It contains mucin, white blood cells, water, inorganic salts, and shed cells, and it serve to lubricate body parts and to trap particles of dirt or other contaminants.
Phlegm —Thick mucus produced in the air passages.
Respiratory system —The organs that are involved in breathing: the nose, the throat, the larynx, the trachea, the bronchi and the lungs. Also called the respiratory tract.
Secretion —A substance, such as saliva or mucus, that is produced and given off by a cell or a gland.
Trachea —The windpipe. A tube composed of cartilage and membrane that extends from below the voice box into the chest where it splits into two branches, the bronchi, that lead to each lung.
These drugs, and others, are not in common use, although wild cherry syrup may be used as a flavoring agent in some liquid cough preparations. Some home remedies, including chicken soup and hot tea, may also be useful in breaking up mucus.

Q.11. Explain Mode of action for expectorant and Aluminium chloride as Expectorants?

Expectorants are drugs which enhance the secretion of the sputum by the air passages so that it is easier to remove the phlegm through coughing. They are used in cough mixtures for this purpose they act either by increasing the bronchiole secretion or by making it less viscous (mucolytic agents) Drugs such as ipecacuanha in small doses act as stimulant expectorants. They irritate the lining of the stomach which reflexly stimulates the production of sputum by the glands in the bronchial mucous membrane. Potassium Iodide stimulates the gastric mucosa and reflely increases the bronchiole secretion . Amonium chloride acts like potassium iodide but is less potent Antimony potassium tatrate also used as expectorant.
Potassium iodide is an inorganic compound with the chemical formula KI. This white salt is the most commercially significant iodide compound, with approximately 37,000 tons produced in 1985. It is less hygroscopic (absorbs water less readily) than sodium iodide, making it easier to work with. Aged and impure samples are yellow because of aerialoxidation of the iodide to elemental iodine.

$4\ KI + 2\ CO2 + O2 \rightarrow 2\ K2CO3 + 2I2$

AMMONIUM CHLORIDE

Preparation: Ammonium chloride is made by reacting hydrochloric acid with ammonia the solution is evaporated to dryness.

$$NH3 + HCl = NH4Cl$$

The Product is Purified by recrystallization or by sublimation .

Assay: Formalaldehyde, previously neutrilised to phenolphthalein , is added to the solution of the substance . it fixes the ammonia in ammonium chloride as hexamine . the librated hydrochloric acid is titrated against0.1 M sodium hydroxide , using phenolphthalein as indicator . A modified volhard method was used in IP '66'. Asolution of the substance acidifies with nitric acid is shaken with a measured volume of n/10 silver nitrate , nitrobenzene being previously added .Nitrobenzene is added to coagulate the precipitate of silver chloride , so that it will npt interfere with the titration later of excess of silver nitrate which is determined by titration with N/10 ammonium thiosynate , using ferric ammonium sulphate as indicator.

$$AgNO3 + NH4Cl = AgCl + NH4NO3$$

$$AgNO3 + NH4SCN = AgSCN + NH4NO3$$

Ammonium silver Thiocynate thiocynate

The following is the reaction taking place at the end point when red ferric thiocynate is formed (by reaction of ammonium thiocynate with the indicator ammonium sulphate

$$FeNH4(SO4)2 + 3NH4SCN = Fe(SCN)3 + 2(NH4)2SO4$$

An antidote is a drug, chelating substance, or a chemical that counteracts (neutralizes) the effects of another drug or a poison. There are dozens of different antidotes; however, some may only counteract one particular drug, whereas others (such as charcoal) may help reduce the toxicity of numerous drugs. Most antidotes are not 100% effective, and fatalities may still occur even when an antidote has been given. A poison is a chemical substance capable of producing adverse effects in a living organism Chemicals may be divided into those intended for human use (food, drugs, cosmetics) and those that are not (household products, industrial chemicals, nonfood, nondrug botanicals). Antidotes counteract the effects of poisons by neutralizing them or by antagonizing their physiologic effects. Worldwide, more than 13 million natural and synthetic chemicals have been identified. Suspecting and identifying cases of poisoning and accurately assessing a poison's potential toxicity are critical to successful management because treatment is merely supportive unless a specific toxicologic symptom complex is diagnosed. Only 30% of all poisoned patients require hospitalization They account for 5-10% ED visits, 3-5% of ICU admissions and up to 30% of psychiatric admission.

Sodium nitrite:

Sodium nitrite is the inorganic compound with the chemical formula NaNO 2. It is a white to slight yellowish crystalline powder that is very soluble in water and is hygroscopic.

It is a useful precursor to a variety of organic compounds, such as pharmaceuticals, dyes, and pesticides, but it is probably best known as a food additive to prevent botulism.

SODIUM THIOSULPHATE:

PREPARATION

1. One half of a concentrated solution of sodium carbonate is saturated with sulphur dioxide and the other half is added to it. Sodium sulphate is formed.

$$Na2CO3 + 2SO2+H2O= 2NAHSO3+CO2$$

$$2NAHSO3+Na2CO3 = Na2SO3+H2O+CO2$$

Sodium thiosulphate solution is prepared by boiling sodium sulphide solution with flowers of sulphur and stirring till alkaline reaction is disappeared.

$$Na2SO3+S=Na2S2O3$$

In the excess of sulphur is filtered off and the filtrate evaporated to crystallization when crystals of sodium thiosulphate (Na2S2O3.5H2O) separate on colling. It can also be prepared by [passing sulphur dioxide into sodium sulphide solution

$$2Na2S+3SO2=2Na2S2O3$$

ASSAY An accurately weighed quantity is dissolved in water and the solution is titrated with 0.05m Iodine, using starch as an indicator towards the end of the titration,appereance of blue colour is the end point.

$$I2 +Na2S2O3=Na2S4O6+2NaI$$

STORAGE:

Since it is deliquescent in moist air and efflorescent in dry air, it must be stored in a tightly closed air tight containers.

MEDICINAL USES

It is also used as an Anti-Fungal agent. Sometimes it is used as catharthic. During bleaching of textiles, it used as an antichlore. It is used in the extraction of gold and silver from their ores.

Q.12. Discuss raw material as sources of impurities?

Impurities in pharmaceuticals are the unwanted chemicals that remain with the active pharmaceutical ingredients (APIs), or develop during formulation, or upon aging of both API and formulated APIs to medicines. The presence of these unwanted chemicals even in small amounts may influence the efficacy and safety of the pharmaceutical products. Impurity profiling the identity as well as the quantity of impurity in the pharmaceuticals is now getting receiving important critical attention from regulatory authorities. The different pharmacopoeias, such as the British Pharmacopoeia (BP) and the United States Pharmacopoeia (USP), are slowly incorporating limits to allowable levels of impurities present in the APIs or formulations.

At the time of contact between processing materials and storage bags, closure, filters, tubing material etc. Impurities also introduce during storage of compound. Impurities also coming from label, ink, overwrap, cardboard, boxes etc. Impurities can be present at the synthesis of product (called genotoxic impurities) that is solvent, residues, catalysts, reaction product in synthesis etc.

Method for impurity detection:

1. Isolation and characterization
2. Column chromatography
3. Gas chromatography

4. Flash chromatography
5. TLC
6. GC
7. HPLC
8. HPTLC
9. Capillary electrophoresis (CE)

Impurities present in the staring materials could follow the same reaction pathways as the starting material itself, and the reaction products could carry over to the final product as process impurities. Knowledge of the impurities in starting materials helps to identify related impurities in the final product, and to understand the formation mechanisms of these related process impurities. One such example is the presence of a 4-trifluoromethyl positional isomer in 3- trifluoromethyl-alpha-ethylbenzhydrol (flumecinol), due to the presence of 4- trifluoromethylbenzene impurity in the starting material, 3-trifluoromethylbenzene. A second example involves a 2-methyl analogue present as a trace impurity in tolperisone, due to the presence of 2-methylpropiophenone in the starting material, 4-methylpropiophenone. These chemicals are less commonly found in APIs; however, in some cases they may pose a problem as impurities. Chemical reagents, ligands, and catalysts used in the synthesis of a drug substance can be carried over to the final products as trace level impurities. For example, carbonic acid chloromethyl tetrahydro-pyran-4-yl ester (CCMTHP), which is used as an alkylating agent in the synthesis of a ß lactam drug substance, was observed in the final product as an impurity. Many chemical reactions are promoted by metal based catalysts. For instance, a Ziegler-Natta catalyst contains titanium, Grubb's catalyst contains ruthenium, and Adam's catalyst contains platinum. In some cases, reagents or catalysts may react with intermediates or final products to form by-products. Pyridine, a catalyst used in the course of synthesis of mazipredone, reacts with an intermediate to form a pyridinium impurity.

Impurities can also be formed by degradation of the end product during manufacturing of bulk drugs. Degradation products resulting from storage or formulation to different dosage forms or aging are common impurities in the medicines. The definition of degradation product in the ICH guidelines is a molecule resulting from a chemical change in the substance brought about by overtime or due to the action of light, temperature, pH or water or by reaction with excipient and/or the intermediate container closure system. For example in the case of aspartame, in the presence of moisture, hydrolysis occurs to form the degradation products L- aspartyl- LPhenyalanine and 3-benzyl-6-carboxymethyl 2, 5-diketopierazine. A third degradation product β-L- aspartyl-L-phenylalanine methyl ester is also known to form. Aspartame degradation also occurs during prolonged heat treatment.

Starting materials and intermediates are the chemical building blocks used to construct the final form of a drug substance. Unreacted starting materials and intermediates, particularly those involved in the last steps of the synthesis, can potentially survive the synthetic and purification process and appear in the final product as impurities. For example, in the synthesis of tipranavir drug substance, aniline is the intermediate in the last step of the synthesis. Due to the similarity between the structures of aniline and the

final product, it is difficult to totally eliminate it in the subsequent purification step. Consequently, it appears in the drug substance at around 0.1% .

Q.13. Explain properties and uses of boric acid and copper sulfate?

Boric acid:

Boric acid, also called hydrogen borate, boracic acid, orthoboric acid and *acidum boricum*, is a weak, tribasic Lewis acid of boron, which is often used as an antiseptic, insecticide, flame retardant, neutron absorber, or precursor to other chemical compounds. It has the chemical formula H_3BO_3 (sometimes written $B(OH)_3$), and exists in the form of colorless crystals or a white powder that dissolves in water. When occurring as a mineral, it is called sassolite.

Boric acid, or sassolite, is found mainly in its free state in some volcanic districts, for example, in the Italian region of Tuscany, the Lipari Islands and the US state of Nevada. In these volcanic settings it issues, mixed with steam, from fissures in the ground. It is also found as a constituent of many naturally occurring minerals – borax, boracite, ulexite (boronatrocalcite) and colemanite. Boric acid and its salts are found in seawater. It is also found in plants, including almost all fruits.

Preparation

Boric acid may be prepared by reacting borax (sodium tetraborate decahydrate) with a mineral acid, such as hydrochloric acid:

$$Na_2B_4O_7{\cdot}10H_2O + 2\ HCl \rightarrow 4\ B(OH)_3\ [or\ H_3BO_3] + 2\ NaCl + 5\ H_2O$$

It is also formed as a by product of hydrolysis of boron trihalides and diborane:[3]

$$B_2H_6 + 6\ H_2O \rightarrow 2\ B(OH)_3 + 6\ H_2$$

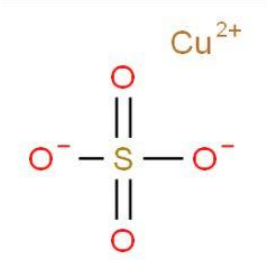
$$BX_3 + 3\ H_2O \rightarrow B(OH)_3 + 3\ HX\ (X = Cl, Br, I)$$

Copper sulfate

Copper sulfate is a term that can refer to either of the following chemical compounds – cuprous sulfate (Cu_2SO_4), or cupric sulfate ($CuSO_4$). However, the latter is the preferred compound described by the term 'copper sulfate'. The systematic name for $CuSO_4$ is copper(II) sulfate, but it is also referred to as blue vitriol, Roman vitriol, the vitriol of copper, and bluestone.

The most common form of copper sulfate is its pentahydrate, given by the chemical formula $CuSO_4.5H_2O$. This form of the salt is characterized by its bright blue color. However, it can be noted that the anhydrous form of this salt is a powder that is white in color.

The $CuSO_4$ molecule consists of an ionic bond between the copper cation (Cu^{2+}) and the sulfate anion (SO_4^{2-}). An illustration describing the structure of a copper sulfate molecule is provided below.



Copper sulfate can be prepared by treating metallic copper with heated and concentrated sulfuric acid, or by treating the oxides of copper with dilute sulfuric acid. It can be noted that the oxidation state exhibited by the copper atom in a $CuSO_4$ molecule is +2.

Properties of $CuSO_4$

The physical and chemical properties of copper sulfate are discussed in this subsection. It can be noted that the properties of anhydrous $CuSO_4$ and $CuSO_4.5H_2O$ vary considerably, and have been highlighted separately.

Physical Properties

- The molar mass of the anhydrous and the pentahydrate forms of copper sulfate are 159.609 grams/mole and 249.685 grams per mole respectively.
- Anhydrous $CuSO_4$ has a grey-white, powdery appearance whereas the pentahydrate has a bright blue color.
- The densities of the anhydrous and pentahydrate forms are 3.6 grams per cubic centimeter and 2.286 $g.cm^{-3}$
- Both hydrated and anhydrous copper sulfates tend to decompose on heating and hence do not have exact boiling points.
- Anhydrous $CuSO_4$ has an orthorhombic crystal structure whereas $CuSO_4.5H_2O$ crystals have triclinic structures.

Chemical Properties

- The copper ions present in copper sulfate react with the chloride ions belonging to concentrated hydrochloric acid, leading to the formation of tetrachlorocuprate(II).
- When heated to 650^oC, $CuSO_4$ undergoes a decomposition reaction to yield cupric oxide (CuO) and SO_3(sulfur trioxide).
- Copper sulfate is highly soluble in water, with solubility values of 1.055 molal and 1.502 molal ate 10^oC and 30^oC respectively.

Uses of Copper Sulfate

Basic chemistry sets that are used as educational tools generally include copper sulfate. The chemical compound $CuSO_4$ has a wide range of applications. Some of these uses are listed below.

- The pentahydrate of this compound, $CuSO_4.5H_2O$ is used as a fungicide due to its ability to kill several fungi.
- Copper sulfate is used in Benedict's solution and in Fehling's solution, which is used in testing for reducing sugars.
- It is also used to test blood samples for diseases like anemia.
- $CuSO_4$ is mixed with $KMnO_4$ (potassium permanganate) to form an oxidant which can be used in the conversion of 1^o
- It is also used as a dye fixative in the process of vegetable dyeing.
- Solutions of copper sulfate in water can be used as a resistive element liquid resistors.
- It can also be used as a decorative since it can add color to cement, ceramics, and other metals as well.
- Copper sulfate is also added to bookbinding glues in order to protect the printed paper from insects.

Q.14. Explain different types of Ash value in term of impurities?

The ash content of a crude drug is generally taken to be the residue remaining after incineration. It usually represents the inorganic salts naturally occurring in the drug and adhering to it, but it may also include inorganic matter added for the purpose of adulteration. There is a considerable difference varies within narrow limits in the case of the same individual drug. Hence an ash determination furnishes a basis for judging the identity and cleanliness of a drug and gives information relative to its adulteration with inorganic matter. Ash standards have been established for a number of official drugs. Usually these standards get a maximum limit on the total ash or on the acid insoluble ash permitted.

The total ash is the residue remaining after incineration. The acid insoluble ash is the part of the total ash which is insoluble in diluted hydrochloric acid.

The ash or residue yielded by an organic chemical compound is as a rule, a measure of the amount of inorganic matters present as impurity. In most cases, the inorganic matter is present in small amounts which are difficult to remove in the purification process and which are not objectionable if only traces are present. Ash values are helpful in determining the quality and purity of the crude drugs in powder form.

Procedures given in Indian pharmacopoeia were used to determine the different ash values such as total ash and acid insoluble ash.

Total ash

Weighed accurately about 3 gm of air dried powdered drug was taken in a tarred silica crucible and incinerated by gradually increasing the temperature to make it dull red until free from carbon cooled and weighted and then calculated the percentage of total ash with reference to the air dried drug.

Acid insoluble ash

The ash obtained as directed under total ash above was boiled with 25 ml of 2N HCl for 5 minutes. The insoluble matter was collected on ash less filter paper, washed with hot water ignited and weighed, then calculated the percentage of acid insoluble ash with reference to the air dried drug.

Water soluble ash

The total ash obtained was boiled with 25 ml of water for 5 minutes. The insoluble matter was collected on an ash less filter paper, washed with hot water and ignited for 15 minutes at a temperature not exceeding 450ËšC. The weight of insoluble matter was subtracted from the weight of total ash. The difference in weight represents the water soluble ash. The percentage of water soluble ash calculated with reference to the air dried drug.

b. EXTRACTIVE VALUES

Extractive values of crude drugs are useful for their evaluation, especially when the constituents of a drug cannot be readily estimated by any other means. Further, these values indicate the nature of the constituents present in a crude drug.

Determination of alcohol soluble extractive value

5 gm of the air-dried coarse powder of Anogeissus latifolia wall (Roxb.ex.DC) was macerated with 100 ml of 90% ethanol in a closed flask for 24 hours, shaking frequently during the first 6 hours and allowing standing for 18hours. Thereafter, it was filtered

rapidly taking precautions against the loss of the solvent. Out of that filtrate, 25 ml of the filtrate was evaporated to dryness in a tarred flat bottomed shallow dish, dried at 105ËšC and weighed. The percentage of ethanol soluble extractive value was calculated with reference to the air- dried drug. The results are recorded in the table.

Determination of water soluble extractive value

Weigh accurately 5 gm of coarsely powdered drug and macerate it with 100 ml of chloroform water in a closed flask for 24 hours, shaking frequently during the first 6 hours and allow to standing for 18 hours. Thereafter, it was filtered rapidly taking precautions against loss of the solvent. Then 25 ml of the filtrate was evaporated to dryness in a tarred flat bottomed shallow dish, dried at 105ËšC and weighed. The percentage of water soluble extractive was calculated with reference to the air dried drug. The results are given in the table.

c. LOSS ON DRYING

Loss on drying is the loss in weight in percentage w/w determined by means of the procedure given below. It determines the amount of volatile matter of any kind (including water) that can be driven off under the condition specified (Desiccators or hot air oven). If the sample is in the form of large crystals, then reduce the size by quick crushing to a powder.

Procedure

About 1.5 gm of powdered drug was weighed accurately in a tarred porcelain dish which was previously dried at 105ËšC in hot air oven to constant weight and then weighed. From the difference in weight, the percentage loss of drying with reference to the air dried substance was calculated.

d. FLUORESCENCE ANALYSIS [Kokate.C.K, 2002; Khandelwal KR 1996].

In the near-ultra region of the spectrum (3000-4000AËš) some of the phytoconstituents show more or less brilliant coloration when exposed to radiation. This phenomenon of emitting visible wavelengths as a result of being excited by radiation of a different wavelength is known as fluorescence. Sometimes the amount of ultra-violet light normally present with visible light is sufficient to produce the fluorescence, but often a more powerful source of ultra-violet is necessary, e.g. mercury vapour lamp. It is often possible to make use of this phenomenon for the qualitative examination of herbal drugs. A fluorescence characteristic of the powdered leaves of Anogeissus latifolia wall (Roxb.ex.DC) was observed in daylight and UV light. Also the fluorescent study was performed on treating the drug powder with different chemical reagents. The observed results are given in table.

e. FOAMING INDEX: [Divakar M.C., 1996]

Foaming index is mainly performed to determine the saponin content in an aqueous decoction of plant material.

Assignment-1

Question	Details	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Explain Mode of action for expectorant and Aluminium chloride as Expectorants?	**3**	**CO3**	**2**
2	Discuss raw material as sources of impurities?	**3**	**CO3**	**2**
3	Explain properties and uses of boric acid and copper sulfate?	**3**	**CO4**	**3**
4	Explain different types of Ash value in term of impurities?	**3**	**CO3**	**1**

ASSIGNMENT-2

Question	Details	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Write a note on Limit Test of Iron	**4**	**CO1**	**2**
2	Write physiological role of sodium and chloride?	**4**	**CO2**	**2**
3	What are topical Agent and discuss the mechanism of topical antimicrobial agent? Discuss uses, assay and properties of zinc oxide and Hydrogen peroxide?	**4**	**CO2**	**2**
4	What is expectorant?	**4**	**CO1**	**1**

CLASS TEST-1

Question	Details	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	What is hardness of water? Explain in detail to remove temporary and permanent hardness of water?	5	**3**	**CO1**	**1**
2	Classify the GIT agent with example of each class and write in detail about saline cathartics?	5	**3**	**CO2**	**2**
3	Write preparation properties and uses of Calcium carbonate?	5	**3**	**CO1**	**2**
4	Explain in brief about Acidifying Agents?	5	**3**	**CO1**	**2**

OPEN BOOK TEST

Question	Details	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Write about pharmaceutical application of radioactive substances.	2	Unit no 5	CO1	2
2	Write about Radiopharmaceuticals?	2	Unit no 5	CO2	3
3	Write about Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents	2	Unit no 2	CO2	1
4	What are the sources of impurities in pharmaceutical substances? Explain the Principle for the Limit test for sulphate.	2	Unit no 1	CO2	3
5	Write about Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy	2	Unit no 2	CO2	2

University question papers, 2013 -2014-2015

Total No. of Questions : 6] **SEAT No. :**

P3139 **[Total No. of Pages : 2**

[5245]-103
First Year B. Pharmacy (Semester - I)
PHARMACEUTICAL INORGANIC CHEMISTRY (1.1.3T)
(2013 Pattern)

Time : 3 Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Figures to the right indicate full marks.***

SECTION - I

Q1) Attempt any one from the following. **[10]**

a) What is Hardness of Water? Explain in detail methods to remove Temporary and Permanent hardness of water.

b) Classify gastrointestinal agents along with examples of each class. Write in detail about saline catharatics.

Q2) Solve any five from the following- **[15]**

a) Write the preparation properties and uses of calcium carbonate.

b) Define Monograph. Explain the term Solubility in Monograph.

c) Explain in brief Acidifying agents.

d) Explain Bismuth compounds as GI protectives and adsorbents.

e) Explain Physiological role of Iodine in brief.

f) Draw well labeled diagram of Gutzeit Apparatus for limit test of Arsenic.

g) Write Preparation, properties and uses of Ferrous Sulphate.

Q3) Solve any two from the following- **[10]**

a) Write a note on Limit test of iron.

b) Write a note on Inorganic gases used in pharmacy.

c) Electrolytes combination therapy

d) Write Physiological role of Sodium and Chloride ions.

P.T.O.

SECTION - II

Q4) Attempt any one from the following : **[10]**

a) Explain in detail electrolytes used in acid base combination therapy.

b) What are topical agents? Discuss the mechanism of action of topical antimicrobial agents. Discuss properties, uses and assay of Hydrogen Peroxide and Zinc Oxide.

Q5) Solve any five from the following- **[15]**

a) Explain mode of action of expectorant. Explain Ammonium Chloride as expectorant.

b) Define along with examples-

i) Anticaries agents

ii) Astringents

iii) Antidotes

c) Discuss raw material as source of impurity.

d) Write short note on properties and uses of sodium thiosulphate.

e) Explain Barium Sulphate as radio opaque contrast media.

f) Explain different types of Ash values in relation to impurity.

g) Explain properties and uses of boric acid and copper sulphate.

Q6) Solve any two from the following- **[10]**

a) Explain in brief electrolyte replacement therapy.

b) Write a note on Dental Products.

c) Explain properties uses and storage of Magnesium Hydroxide.

d) Role of Calcium and Bicarbonate in our body.

Total No. of Questions : 6]

SEAT No. :

P1967

[Total No. of Pages : 3

[5145]-103

F.Y. B.Pharmacy

1.1.3T: PHARMACEUTICAL INORGANIC CHEMISTRY

(2013 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Figures to the right indicate full marks.*

SECTION - I

Q1) Attempt any ONE of the following: **[10]**

a) Write in detail the different sources of Impurities in Pharmaceuticals.

b) Explain Limit test of Iron and Lead in detail.

Q2) Solve any FIVE of the following: **[15]**

a) Write a note on ORS.

b) Discuss the role of Potassium and chloride in our body.

c) Explain why combination of Aluminium and Magnesium antacid is used?

d) Define Monograph. Write in brief storage conditions as per I.P.

e) Write brief history of Indian Pharmacopoeia.

f) Why water is called as universal pharmaceutical vehicle?

g) Give the properties and uses of Titanium Dioxide as topical protectives.

h) What are Antidepressants? Explain Lithium Carbonate as inorganic antidepressant.

P.T.O.

Q3) Solve any two of the following: **[10]**

a) Explain GIT protective and Adsorbent along with one example each.

b) Write a note on electrolytes used in Acid Base Therapy.

c) Discuss official control test of water.

d) Write Physiological role of Copper and Iodine.

SECTION - II

Q4) Attempt any ONE of the following: **[10]**

a) What are topical agents? Explain mechanism of action of Antimicrobial agents. Discuss Preparation Properties, assay and uses of Hydrogen Peroxide.

b) Define and classify Antacids. Explain ideal properties of Antacids. How they are evaluated. Write properties and uses of calcium carbonate and Magnesium Hydroxide.

Q5) Solve any FIVE of the following: **[15]**

a) Define along with examples-i) Anticaries agents, ii) Astringents, iii) Antidotes.

b) Write storage and labeling conditions for Nitrogen, Nitrous oxide and Helium as inorganic gases.

c) Write short note on properties and uses of sodium thiosulphate

d) Write in brief about Sodium Fluoride as Anticaries agent.

e) Write a note on Zinc as trace ion.

f) Define Hardness of Water. Enlist methods used to remove temporary and permanent hardness of water

g) Explain role of lead acetate cotton plug in limit test for Arsenic.

Q6) Solve any TWO of the following: **[10]**

a) Explain Barium Sulphate as Radio opaque Contrast Media.

b) Write a note on Aluminium Chloride as an expectorant.

c) Explain Properties and uses of Oxygen and Carbon dioxide as official Inorganic gas.

d) What are topical protective agents? Explain in detail Talc and Zinc oxide as protectives.

❄ ❄ ❄

Total No. of Questions : 6]

SEAT No. :

P1428

[Total No. of Pages : 3

[5049]-103
F.Y.B.Pharmacy
PHARMACEUTICAL INORGANIC CHEMISTRY
(2013 Pattern) (Semester - I)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *All questions are compulsory.*
2) *Answers to the two sections should be written in separate answer books.*
3) *Figures to the right indicate full marks.*

SECTION - I

Q1) Attempt any one from the following: **[10]**

a) Define Limit test. Explain in detail limit test of Arsenic and Iron.

b) Define Antacids. Write ideal properties of Antacids. Explain combination of Antacids in detail with two examples.

Q2) Solve any five from the following: **[15]**

a) Write a note History of Indian Pharmacopoeia.

b) Discuss Preparation, properties and uses of Bismuth compounds.

c) Define Hardness of water and enlist methods to remove temporary and permanent hardness of water.

d) Define Monograph. Explain the term Storage condition in Monograph.

e) Explain in brief Acidifying agents.

f) Write Preparation, Properties and uses of Sodium Hypochlorite.

g) Explain in brief Copper as trace ion.

P.T.O.

Q3) Solve any two from the following: **[10]**

a) Role of Calcium and Bicarbonate in our body.

b) Explain in brief electrolyte replacement therapy.

c) Discuss official control test of water.

d) Write in brief about role of zinc as base ion and give properties and uses of Zinc Sulphate.

SECTION - II

Q4) Attempt any one from the following: **[10]**

a) Explain in detail electrolytes used in acid base combination therapy.

b) What are Antimicrobial agents? Explain their mode of action. Write Properties, assay and uses of Potassium Permanganate.

Q5) Solve any five from the following: **[15]**

a) Define along with examples

i) Anticaries agents

ii) Astringents

iii) Antidotes

b) Write storage and labeling conditions for Nitrogen, Nitrous oxide and Oxygen as inorganic gases.

c) Write short note on properties and uses of sodium thiosulphate.

d) Write in brief about Sodium Fluoride as Anticaries agent.

e) Write a note on Zinc as trace ion.

f) Enlist the contents of individual monographs.

g) Explain ORS (Oral Rehydration Salt).

Q6) Solve any two from the following: **[10]**

a) Explain Barium Sulphate as Radio opaque Contrast Media.

b) Write a note on Ammonium Chloride as a expectorant.

c) Explain Properties and uses of sodium potassium tartarate and magnsium sulphate.

d) What are topical protective agents? Explain in detail Talc and Zinc oxide as protectives.

Subject IV

BP105T COMMUNICATION SKILLS

SCHEME

BP105T Communication Skills

SCHEME FOR INTERNAL AND END SEMESTER EXAMINATIONS

Course Code	Course Name	Evaluation Scheme						
		Internal Assessment				End Semester Exams		Total Marks
		Continuous Assessment Mode	Sessional Marks		Total	Marks	Duration	
			Marks	Duration				
BP105T	Communication skills – Theory	2	2	1.5	35	13	1	10
BP111P	Communication skills – Practical	2	1	2	15	6	2	5

SYLLABUS

BP105T Communication Skills

COURSE CONTENT	
UNIT-I	**07 Hours**
Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process-Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment	
UNIT-II	**07 Hours**
Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	
UNIT-III	**07 Hours**
Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	
UNIT-IV	**05 Hours**
Interview Skills: Purpose of an interview, Do's and Dont's of an interview **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	
UNIT-V	**04 Hours**

Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

Recommended Books: (Latest Editions)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011

2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011

3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013

4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011

5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013

6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010

7. Communication skills for professionals, Konar Nira, 2ndEdition, New arrivals – PHI, 2011

8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011

9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India pvt.ltd, 2011

10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011

11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009

12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

LESSION PLAN

Sub: Communication Skills (Theory)

Name of the faculty: Mr. V. M. Dhamak

Lecture No.	Description	References	Cos	Pos
1	**Communication Skills:** Introduction, Definition, The Importance of Communication	Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011	CO1	PO1
2	The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context		CO1	PO1
3	**Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers,	Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013	CO1	PO7
4	Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers		CO1	PO7
5	**Perspectives in Communication:** Introduction,	Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013	CO1	PO8
6	Visual Perception, Language		CO1	PO8
7	Otherfactors affecting our perspective - Past Experiences, Prejudices, Feelings,Environment		CO1	PO8
8	**Elements of Communication:** Introduction	Brilliant-Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011	CO1	PO8
9	Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication)		CO1	PO8
10	Verbal Communication		CO1	PO8
11	Physical Communication		CO1	PO8
12	**Communication Styles:** Introduction	Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011	CO2	PO9
13	The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style		CO2	PO9
14	Systematic Communication Style, Considerate Communication		CO2	PO9

	Style			
15	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening		CO2	PO9
16	Becoming an Active Listener, Listening in Difficult Situations		CO2	PO9
17	**Effective Written Communication:** Introduction, When and When Not to Use Written Communication	Effective communication, John Adair, 4th Edition, Pan Mac Millan,2009	CO2	PO9
18	Complexity of the Topic, Amount of Discussion' Required		CO2	PO9
19	Shades of Meaning, Formal Communication		CO2	PO9
20	**Writing Effectively:** Subject Lines, Put the Main Point First		CO2	PO9
21	Know Your Audience, Organization of the Message		CO2	PO9
22	**Interview Skills:** Purpose of an interview	Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011	CO3	PO11
23	Do's and Dont's of an interview		CO3	PO11
24	**Giving Presentations:** Dealing with Fears	Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011	CO3	PO12
25	Planning your Presentation, Structuring Your Presentation		CO3	PO12
26	Delivering Your Presentation, Techniques of Delivery		CO3	PO12
27	**Group Discussion:** Introduction	Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011	CO3	PO12
28	Communication skills in group discussion		CO3	PO12
29	Do's and Dont's of group discussion		CO3	PO12
30	Do's and Dont's of group discussion		CO3	PO12

COURSE DELIVERY, OBJECTIVES, OUTCOMES

BP105T. COMMUNICATION SKILLS

Course Delivery

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

1. To understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. To communicate effectively (Verbal and Non Verbal)
3. To effectively manage the team as a team player
4. To develop interview skills
5. To develop leadership qualities and essentials

Course Outcomes (COs):

After successful completion of course student will able to

BP105T.1	Learner will be able to understand behavioral needs for a Pharmacist to communicate effectively in areas of pharmaceutical operations
BP105T.2	Learner will be able to lead the team and effectively manage it.
BP105T.3	Learner will have effective presentation and interview skills

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
If there is no correlation, put "-"

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
CO1	2	2	3	-	-	-	2	2	2	3	2	3	2	-	2
CO2	-	-	-	-	-	-	2	-	3	-	2	-	-	-	2
CO3	2	-	-	-	-	-	-	-	3	-	-	2	-	-	-
PDC-course average	2	2	2	-	-	1	2	2	3	3	2	2	2	-	2

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because it demonstrate the knowledge
CO1 with PO2	CO1 is aligned with PO2 because it deals resolving problems through communication
CO1 with PO3	CO1 is aligned with PO3 because it deals understanding of working
CO1 with PO7	CO1 is aligned with PO7 because it deals with professional working
CO1 with PO8	CO1 is aligned with PO8 because it deals with understanding of moral responsibility
CO1 with PO9	CO1 is aligned with PO9 because it deals with accomplishing a common goal through communication
CO1 with PO10	CO1 is aligned with PO10 because it deals communicating effectively with pharmacy community
CO1 with PO11	CO1 is aligned with PO11 because it deals professional development by communication
CO2 with PO7	CO2 is aligned with PO7 because it deals sustainable development of team
CO2 with PO9	CO2 is aligned with PO9 because it deals with functioning effectively as a team
CO2 with PO11	CO2 is aligned with PO11 because it deals professional development by communication
CO3 with PO1	CO3 is aligned with PO1 because it present the knowledge through communication
CO3 with PO9	CO3 is aligned with PO9 because for method development the knowledge of validation is needed in pharmaceutical sciences
Justification of CO-PSO Mapping	
CO1 with PSO1	CO1 is aligned with PSO1 because it deals with the knowledge of communication
CO1 with PSO2	CO1 is aligned with PSO2 because it deals with understanding and applying of knowledge to resolve problems
CO1 with PSO4	CO1 is aligned with PSO4 because one can define the process to meet desired need
CO2 with PSO4	CO2 is aligned with PSO4 because it deals with meeting of desired needs within realistic constraints by communication
CO3 with PSO1	CO3 is aligned with PSO1 because it deals to analyze and communicate with confidence

QUESTION BANK

BP105T. Communication Skills

Sr.no	Questions	CO mapped	Bloom level
	Topic- Communication Skills		
1	Define and state the importance of communication	CO1	3
2	Enlist and explain the communication process in details.	CO1	2
	Barriers to communication		
3	Enlist and elaborate the barriers to communication	CO1	3
4	Write shot note on Physiological barriers	CO1	3
5	Write shot note on Physical barriers	CO1	3
6	Write shot note on Cultural barriers	CO1	2
7	Write shot note on Language barriers	CO1	2
8	Write shot note on Gender barriers	CO1	2
9	Write shot note on Interpersonal barriers	CO1	3
10	Write shot note on Psychological barriers	CO1	3
11	Write shot note on Emotional barriers	CO1	2
	Perspectives in Communication		
12	Write note on perspectives in communication.	CO1	3
13	What are the factors affecting our perspective in communication	CO1	3
	Elements of Communication		
14	Enlist and explain the elements of communication.	CO1	3
15	What is non-verbal communication & verbal communication?	CO1	2
16	Write note on physical communication.	CO1	2
	Communication Styles		
17	Enlist and explain communication styles.	CO2	2

18	Write note on direct communication style.	CO2	3
19	Write note on spirited communication style.	CO2	3
20	Write note on systematic communication style.	CO2	3
21	Write note on considerate communication style.	CO2	3
Basic Listening Skills			
22	What are basic listening skills?	CO2	3
23	Write short note on active listening.	CO2	2
24	Write short note on becoming an active listener.	CO2	2
25	Write short note on listening in difficult situations.	CO2	3
Effective Written Communication			
26	What are effective ways for written communication?	CO2	2
27	What is formal communication?	CO2	3
Writing Effectively			
28	What is process of writing effectively?	CO2	2
Interview Skills			
29	What are do's and dont's of an interview?	CO3	3
Giving Presentations			
30	What are essentials of presentations?	CO3	2
Group Discussion			
31	What communication skills are required for group discussion?	CO3	2
32	What are do's and dont's of group discussion.	CO3	2

Assignment-1

Question	Details	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Enlist and elaborate the barriers to communication	**1**	**CO1**	**3**
2	What are the factors affecting our perspective in communication	**2**	**CO1**	**3**
3	What communication skills are required for group discussion?	**5**	**CO3**	**2**
4	What are do's and dont's of an interview?	**4**	**CO3**	**2**
5	Enlist and explain communication styles.	**3**	**CO2**	**3**

CLASS TEST-1

Question	Details (Any Five)	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Enlist and explain the communication process in details.	2	**1**	**CO1**	**2**
2	Write shot note on Gender barriers	2	**1**	**CO1**	**2**
3	Write note on perspectives in communication.	2	**1**	**CO1**	**3**
4	Enlist and explain the elements of communication.	2	**2**	**CO1**	**3**
5	Write shot note on Psychological barriers.	2	**1**	**CO1**	**3**
6	Write note on physical communication.	2	**3**	**CO1**	**2**
7	Define and state the importance of communication	2	**2**	**CO1**	**2**

CLASS TEST-II

Question	Details (Any Five)	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Write note on systematic communication style.	2	**3**	**CO2**	**3**
2	Write short note on listening in difficult situations.	2	**3**	**CO2**	**3**
3	What are effective ways for written communication?	2	**3**	**CO2**	**2**
4	What are do's and dont's of an interview?	2	**4**	**CO3**	**3**
5	What are essentials of presentations?	2	**4**	**CO3**	**2**
6	What are do's and dont's of group discussion.	2	**5**	**CO3**	**2**
7	What are basic listening skills?	2	**3**	**CO2**	**3**

End Semester Examination Question Paper, 2018
PRES College of Pharmacy (Women's), Chincholi, Sinnar

First Semester Examination Dec. 2018-19	Communication Skills	Sem-1	25/12/2018	Marks-35

Q.1 Long Answer Question (Answer any one) **(10x1)**

a. Explain the purpose of interview and steps before going to interview. What are do and dont's during interview?

b. Draw and explain process of communication.

Q.2 Short Answer Question (Answer any five) **(5x5)**

a. Enlist and explain barriers of communication?

b. Write note on listening in difficult situation.

c. Write note effective written communication.

d. Write note on do's and dont's of group discussion.

e. Write note on delivering presentation.

f. Write note on verbal communication?

g. What is visual communication?

SUBJECT VI

BP106 RBT REMEDIAL BIOLOGY

SCHEME

BP106RBT. REMEDIAL BIOLOGY

Course of study

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP106RBT	Remedial Biology	02	-	-	02
BP112RBP	Remedial Biology	-	02	-	01

Schemes for internal assessments and end semester examinations

Course Code	Course Name	Internal Assessment				End Semester Exams		Total Marks
			Sessional Exams					
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP106 RBT	RB	5	10	1 Hrs	15	35	1.5 Hrs	50
BP112 RBP	RB	5	5	2 Hrs	10	15	2 Hrs	25

SYLLABUS

BP106RBT. Remedial Biology

(Theory)

30 Hours

Scope:

To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon completion of the course the student shall be able to

- know the classification and salient features of five kingdoms of life
- understand the basic components of anatomy & physiology of plant
- know understand the basic components of anatomy & physiology animal with special reference to human

COURSE CONTENT	
UNIT-I	**07 Hours**
Living world: Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.	
UNIT-II	**07 Hours**
Body fluids and circulation Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels Cardiac cycle, cardiac output and ECG **Digestion and Absorption** Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food **Breathing and respiration** Human respiratory system Mechanism of breathing and its regulation Exchange of gases, transport of gases and regulation of respiration Respiratory volumes	
UNIT-III	**07 Hours**
Excretory products and their elimination Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotensin system **Neural control and coordination** Definition and classification of nervous system Structure of a neuron Generation and conduction of nerve impulse Structure of brain and spinal cord Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata **Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands	

Human reproduction
Parts of female reproductive system
Parts of male reproductive system
Spermatogenesis and Oogenesis
Menstrual cycle

UNIT-IV	**05 Hours**

Plants and mineral nutrition:
Essential mineral, macro and micronutrients
Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation
Photosynthesis
Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

UNIT-V	**04 Hours**

Plant respiration: Respiration, glycolysis, fermentation (anaerobic).
Plant growth and development
Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators
Cell - The unit of life
Structure and functions of cell and cell organelles. Cell division
Tissues
Definition, types of tissues, location and functions.

Recommended Books:
Text Books
a. Text book of Biology by S. B. Gokhale
b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books
a. A Text book of Biology by B.V. Sreenivasa Naidu
b. A Text book of Biology by Naidu and Murthy
c. Botany for Degree students By A.C. Dutta.
d. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

LESSON PLAN

BP106RBT REMEDIAL BIOLOGY

Bloom Levels (BL): 1. Remember 2. Understand 3. Apply 4. Create				
Lect. No.	Topics / Sub- Topics	CO'S Addressed	BL Level	Reference (Text Book, Website)
1	**Living world:** Definition and characters of living organisms, Diversity in the living world, Binomial nomenclature.	1	1	Textbook of Remedial Biology
2	Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus.	1	2	
3	**Morphology of Flowering plants** Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed.	2	2	
4	General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.	2	**2**	
5	**Body fluids and circulation** Composition of blood, blood groups, coagulation of blood, Composition and functions of lymph.	4	1	
6	Human circulatory system- Structure of human heart and blood vessels, Cardiac cycle, cardiac output and ECG.	4	1	
7	**Digestion and Absorption** Human alimentary canal and digestive glands, Role of digestive enzymes	4	1	
8	Digestion, absorption and assimilation of digested food	4	1	
9	**Breathing and respiration** Human	4	1	

	respiratory system, Mechanism of breathing and its regulation.			
10	Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes.	5	1	
11	**Excretory products and their elimination** Modes of excretion, Human excretory system- structure and function.	5	2	
12	Urine formation, Rennin angiotensin system	5	2	
13	**Neural control and coordination** Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse,	5	2	
14	Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata.	5	2	
15	**Chemical coordination and regulation** Endocrine glands and their secretions	3	1	
16	Functions of hormones secreted by endocrine glands	3	1	
17	**Human reproduction** Parts of female reproductive system	3	1	
18	Parts of male reproductive system	3	2	
19	Spermatogenesis and Oogenesis	3	2	
20	Menstrual cycle	3	2	
21	**Plants and mineral nutrition:** Essential mineral, macro and micronutrients	4	1	
22	Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation	4	2	
23	**Photosynthesis** Autotrophic nutrition, photosynthesis	4	2	
24	Photosynthetic pigments, Factors affecting	4	2	

	photosynthesis			
25	**Plant respiration:** Respiration, glycolysis, fermentation (anaerobic).	4	2	
26	**Plant growth and development** Phases and rate of plant growth, Condition of growth,	4	2	
27	Introduction to plant growth regulators	4	2	
28	**Cell - The unit of life** Structure and functions of cell and cell organelles.	4	2	
29	Cell division	6	1	
30	**Tissues** Definition, types of tissues, location and functions.	6	2	

Note: 1.Home Assignment will be given after completion of each unit.

2. Class Test I & II will be conduct as per the schedule of Academic Calendar.

COURSE DELIVERY, OBJECTIVES, OUTCOMES

BP106RBT REMEDIAL BIOLOGY

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

1. To explain & know the classification and salient features of five kingdoms of life
2. To explain basic components of anatomy & physiology of plant
3. To understand the basic components of anatomy & physiology animal with special reference to human.

Course Outcomes (COs):

After successful completion of course student will able to

CO1	Know the classification and salient features of five kingdoms of life
CO2	Understand the basic components of anatomy & physiology of plant
CO3	Know understand the basic components of anatomy & physiology animal with special reference to human

Mapping of Course Outcome (CO) with Program Outcome (PO) and Program Specific Outcome (PSO)

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)
If there is no correlation, put "-"

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3	PS O4
CO1	3	2	2	3	3	-	-	-	-	-	-	3	2	3	3
CO2	3	2	2	3	3	-	-	-	-	-	-	2	1	1	-
CO3	3	2	3	2	3	-	-	-	-	-	-	1	2	2	1
PDC-course average	3	2	2	3	3	-	-	-	-	-	-	2	1	2	2

Justification of CO-PO Mapping

CO1 with PO1	CO1 is aligned with PO1 because it demonstrate the technical knowledge of biosynthetic pathways in plants.
CO1 with PO2	CO1 is aligned with PO2 because it deals with practical observation.
CO1 with PO3	CO1 is aligned with PO3 because it deals with the knowledge.
CO1 with PO4	CO1 is aligned with PO4 because it deals with research based knowledge
CO1 with PO5	CO1 is aligned with PO5 because it deals with the improvement of skills of individuals for handling the diffrent tools
CO2 with PO1	CO2 is aligned with PO1 because it moderately deals with the basic knowledge
CO2 with PO2	CO2 is aligned with PO2 because it moderately deals with the anatomy & Physiology
CO2 with PO3	CO2 is aligned with PO3 because analysis of simple process to meet desired need is useful for the design of new process.
CO2 with PO4	CO2 is aligned with PO4 because through the analysis one can interpret the data and identify the multicomponent of the substances
CO2 with PO5	CO2 is aligned with PO5 because modern analytical tools can be used to improve practical skill in pharmacy practices
CO3 with PO1	CO3 is aligned with PO1 because for method development the knowledge of validation is needed in pharmaceutical sciences
CO3 with PO2	CO3 is aligned with PO2 because method validation is depends on various parameter and it deals with the formulation of stable product
CO3 with PO3	CO3 is aligned with PO2 because for any design of any new process system needs to study the validation parameter of the drugs and formulation.
CO3 with PO4	CO3 is aligned with PO4 because it deals with the design of new process for new formulation of drug
CO3 with PO5	CO3 is aligned with PO5 because it deals with the modern tools used for Practicals
Justification of CO-PSO Mapping	
CO1 with PSO1	CO1 is aligned with PSO1 because it deals with the technical knowledge of subject
CO1 with PSO2	CO1 is aligned with PSO2 because it deals with understanding of the theoretical concept of the techniques and procedures used for analysis
CO1 with PSO3	CO1 is aligned with PSO3 because it defines the method used for the analysis of finished product and also defines the process used for analysis.
CO1 with PSO4	CO1 is aligned with PSO4 because it deals with the knowledge of technique one can define the process to meet desired need
CO2 with PSO1	CO2 is aligned with PSO1because it deal with the theoretical knowledge and practical skill of the instruments
CO2 with PSO2	CO2 is aligned with PSO2 because it deals with understanding of the theoretical concept and practical skills
CO2 with PSO3	CO2 is aligned with PSO3 because it defines the analysis of process and finished product in limits
CO2 with PSO4	CO2 is aligned with PSO3 because it deals with the defining the procedure for the analysis which meet the desired standard of safety for humans
CO3 with PSO1	CO3 is aligned with PSO1 because it deals with the development of technical knowledge of validation skill of analytical method
CO3 with PSO2	CO3 is aligned with PSO2 because it deals with the development of new process

	and procedure for manufacturing new drug
CO3 with PSO3	CO3 is aligned with PSO3 because it deals with the evaluation of drugs and finished products as perICH/USP guidelines
CO3 with PSO4	CO3 is aligned with PSO4 because it deals with the designing of method for stable formulation

QUESTION BANK

CELL AND TISSUE

1. Enlist the basic types of tissue with its characteristic.
2. Describe the structure and location of various types connective of tissue.
3. Explain the structure of nucleus. Describe the sequence of events during protein synthesis.
4. Describe the structure and function of mitochondria.

BLOOD

1. Give the structure and function of RBC.
2. Write a note on WBC.
3. Write a note on platelates
4. Describe the blood clotting mechanism.

LYMPH AND LYMPHATIC SYSTEM.

1. Write a note on lymph node.
2. Write a structure and function of Spleen.
3. Give the composition and function of lymph.
4. Write the structure and function of lymph node.

CARDIOVASCULAR SYSTEM

1. Explain the structure of blood vessels.
2. Explain the structure of heart.
3. Define a blood pressure and explain factor affecting it.

DIAGESTIVE SYSTEM

1. Explain the location anatomy histology of and function of small intestine.
2. Write a note on liver.
3. Give the histology and functions of liver.
4. Explain composition and function of saliva.

PLANT PHYSIOLOGY

1. Write the characteristics of living organisms.
2. Write short note on five kingdom classification.
3. Write note on Plant Growth Regulators.

QUESTION BANK - MODEL ANSWERS

1. Enlist the basic types of tissue with its characteristic.

Ans.: Human body tissue consists of groups of cells with a similar structure working together for a specific function. There are four main types of tissue in a body.

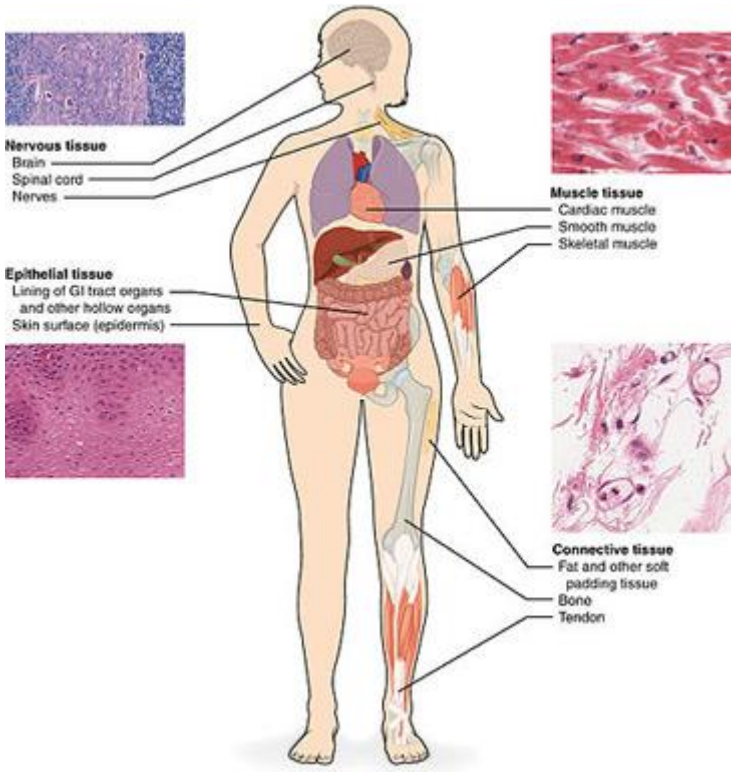
Human Body Tissue

If you were to try to explain to someone what your body is made of, you might say two arms, two legs, feet and hands, a head and a torso. Or, you might go to the other extreme and say that you are made up of billions of cells. Both answers would be correct. However, there is a more specific way to describe what makes up a body. We are composed of several different types of **human body tissue**. But what exactly does that mean?

Human body tissue is another way of describing how our cells are grouped together in a highly organized manner according to specific structure and function. These groupings of cells form tissues, which then make up organs and various parts of the body. For example, it's easy to see and feel muscle in the body. Muscle is one of the four types of human body tissue. In this lesson, learn more about the types of tissue and how each function for a different purpose.

The Types of Tissue

We have determined that we are made up of four different types of tissue. In addition to muscle tissue, we have connective, epithelial and nervous tissue in the body. So, how are these tissue types different? Let's zoom in on each one to better understand.

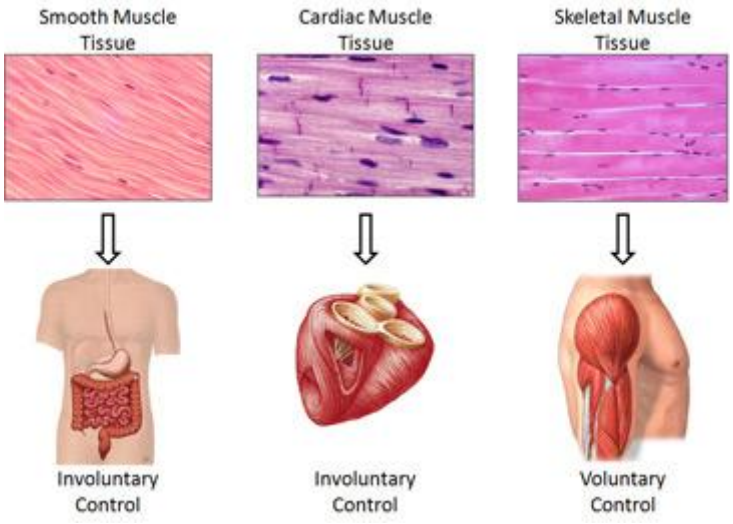


Types of Tissue in Human Body

Muscle Tissue

As mentioned earlier, these different types of tissue are made of particular kinds of cells that work together. First let's look at muscle tissue. **Muscle tissue** is made up of excitable

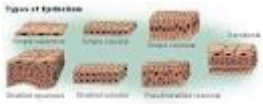
cells that are long and fibrous. These cells are ready for **contraction**, or the activation of tension in our muscles, making it possible for us to move our body parts. They are arranged in parallel lines and are bundled, making muscle tissue very strong. If you take a pile of rubber bands, line them up next to each other and attempt to stretch them, you may get the idea of the nature of the muscle tissue.



Cell Structure of Muscle Tissue

Epithelial Tissue

Epithelial tissue is made up of epithelial cells, which are vastly different from the muscle cells we just talked about. These cells can be flat, cuboidal, or columnar. They are joined tightly together, making a single or stacked continuous sheet. Like a quilt that is tightly stitched, epithelium makes an excellent protective cover for the body, in the form of skin. Epithelial tissue can also be found lining some internal cavities and organs.



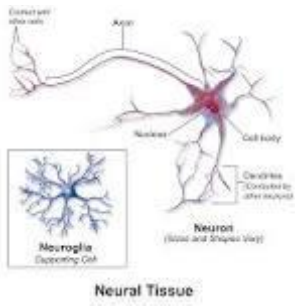
Various Configurations of Epithelial Tissue

Connective Tissue

As its name suggests, **connective tissue** makes up a connective web inside our body. Holding our body parts together and providing support are the main jobs of this tissue. We would certainly not be in good shape if all of our internal body parts were free-floating. Connective tissue fills in the spaces inside our body with a matrix made of fibers within a liquid, solid, or jelly-like substance. Think of a gelatin salad with fruit suspended inside, and you will have an idea of how certain types of connective tissue function.

Nervous Tissue

Nervous tissue is found within the nervous system and is made up of unique specialized cells. Like electrical circuits, the nervous system transmits signals from nerves to the spinal cord and brain. Cells known as **neurons** conduct these impulses, making it possible for us to use our senses.



Neuron with Supporting Tissue

2. **Describe the structure and location of various types connective of tissue.**

Ans: Connective tissue (CT) is one of the four basic types of animal tissue, along with epithelial tissue, muscle tissue, and nervous tissue. It develops from the mesoderm. Connective tissue is found in between other tissues everywhere in the body, including the nervous system. In the central nervous system, the three outer membranes (the meninges) that envelop the brain and spinal cord are composed of connective tissue. They support and protect the body. All connective tissue consists of three main components: fibers (elastic and collagenous fibers), ground substance and cells. Not all authorities include blood or lymph as connective tissue because they lack the fiber component. All are immersed in the body water.

The cells of connective tissue include fibroblasts, adipocytes, macrophages, mast cells and leucocytes.

Connective tissue can be broadly classified into connective tissue proper, and special connective tissue. Connective tissue proper consists of loose connective tissue and dense connective tissue (which is further subdivided into dense regular and dense irregular connective tissues) Loose and dense connective tissue are distinguished by the ratio of ground substance to fibrous tissue. Loose connective tissue has much more ground substance and a relative lack of fibrous tissue, while the reverse is true of dense connective tissue. Dense regular connective tissue, found in structures such as tendons and ligaments, is characterized by collagen fibers arranged in an orderly parallel fashion, giving it tensile strength in one direction. Dense irregular connective tissue provides strength in multiple directions by its dense bundles of fibers arranged in all directions.

Special connective tissue consists of reticular connective tissue, adipose tissue, cartilage, bone, and blood. Other kinds of connective tissues include fibrous, elastic, and lymphoid connective tissues. Fibro areolar tissue is a mix of fibrous and areolar tissue. Fibromuscular tissue is made up of fibrous tissue and muscular tissue. New vascularized connective tissue that forms in the process of wound healing is termed granulation tissue. Fibroblasts are the cells responsible for the production of some CT.

Type I collagen is present in many forms of connective tissue, and makes up about 25% of the total protein content of the mammalian body.

Characteristics of CT:

Cells are spread through an extracellular fluid.

Ground substance - A clear, colorless, and viscous fluid containing glycosaminoglycans and proteoglycans to fix the body water and the collagen fibers in the intercellular spaces. Ground substance slows the spread of pathogens.

Fibers. Not all types of CT are fibrous. Examples of non-fibrous CT include adipose tissue and blood. Adipose tissue gives "mechanical cushioning" to the body, among other functions. Although there is no dense collagen network in adipose tissue, groups of adipose cells are kept together by collagen fibers and collagen sheets in order to keep fat tissue under compression in place (for example, the sole of the foot). The matrix of blood is plasma.

Both the ground substance and proteins (fibers) create the matrix for CT. Connective tissues are derived from the mesenchyme.

Types of fibers:

Tissue	Purpose	Components	Location
Collagenous fibers	Bind bones and other tissues to each other	Alpha polypeptide chains	tendon, ligament, skin, cornea, cartilage, bone, blood vessels, gut, and intervertebral disc.
Elastic fibers	Allow organs like arteries and lungs to recoil	Elastic microfibril and elastin	extracellular matrix
Reticular fibers	Form a scaffolding for other cells	Type III collagen	liver, bone marrow, and lymphatic organs

Function:

Connective tissue has a wide variety of functions that depend on the types of cells and the different classes of fibers involved. Loose and dense irregular connective tissue, formed mainly by fibroblasts and collagen fibers, have an important role in providing a medium for oxygen and nutrients to diffuse from capillaries to cells, and carbon dioxide and waste substances to diffuse from cells back into circulation. They also allow organs to resist stretching and tearing forces. Dense regular connective tissue, which forms organized structures, is a major functional component of tendons, ligaments and aponeuroses, and is also found in highly specialized organs such as the cornea. Elastic fibers, made from elastin and fibrillin, also provide resistance to stretch forces. They are found in the walls of large blood vessels and in certain ligaments, particularly in the ligament flava.

In hematopoietic and lymphatic tissues, reticular fibers made by reticular cells provide the stroma or structural support for the parenchyma or functional part of the organ.

Mesenchyme is a type of connective tissue found in developing organs of embryos that is capable of differentiation into all types of mature connective tissue. Another type of relatively undifferentiated connective tissue is the mucous connective tissue known as Wharton's jelly, found inside the umbilical cord.

Various types of specialized tissues and cells are classified under the spectrum of connective tissue, and are as diverse as brown and white adipose tissue, blood, cartilage and bone. Cells of the immune system, such as macrophages, mast cells, plasma cells and

eosinophils are found scattered in loose connective tissue, providing the ground for starting inflammatory and immune responses upon the detection of antigens.

3. Explain the structure of nucleus. Describe the sequence of events during protein synthesis.

Ans: PROTEIN SYNTHESIS

Learning Objectives

By the end of this section, you will be able to:

- Explain how the genetic code stored within DNA determines the protein that will form
- Describe the process of transcription
- Describe the process of translation
- Discuss the function of ribosomes

It was mentioned earlier that DNA provides a "blueprint" for the cell structure and physiology. This refers to the fact that DNA contains the information necessary for the cell to build one very important type of molecule: the protein. Most structural components of the cell are made up, at least in part, by proteins and virtually all the functions that a cell carries out are completed with the help of proteins. One of the most important classes of proteins is enzymes, which help speed up necessary biochemical reactions that take place inside the cell. Some of these critical biochemical reactions include building larger molecules from smaller components (such as occurs during DNA replication or synthesis of microtubules) and breaking down larger molecules into smaller components (such as when harvesting chemical energy from nutrient molecules). Whatever the cellular process may be, it is almost sure to involve proteins. Just as the cell's genome describes its full complement of DNA, a cell's proteome is its full complement of proteins. Protein synthesis begins with genes. A gene is a functional segment of DNA that provides the genetic information necessary to build a protein. Each particular gene provides the code necessary to construct a particular protein. Gene expression, which transforms the information coded in a gene to a final gene product, ultimately dictates the structure and function of a cell by determining which proteins are made.

The interpretation of genes works in the following way. Recall that proteins are polymers, or chains, of many amino acid building blocks. The sequence of bases in a gene (that is, its sequence of A, T, C, G nucleotides) translates to an amino acid sequence. A triplet is a section of three DNA bases in a row that codes for a specific amino acid. Similar to the way in which the three-letter code d-o-g signals the image of a dog, the three-letter DNA base code signals the use of a particular amino acid. For example, the DNA triplet CAC (cytosine, adenine, and cytosine) specifies the amino acid valine. Therefore, a gene, which is composed of multiple triplets in a unique sequence, provides the code to build an entire protein, with multiple amino acids in the proper sequence (Figure 1). The mechanism by which cells turn the DNA code into a protein product is a two-step process, with an RNA molecule as the intermediate.

This diagram shows the translation of RNA into proteins. A DNA template strand is shown to become an RNA strand through transcription. Then the RNA strand undergoes translation and becomes proteins.

Figure 1. The Genetic Code. DNA holds all of the genetic information necessary to build a cell's proteins. The nucleotide sequence of a gene is ultimately translated into an amino acid sequence of the gene's corresponding protein.

FROM DNA TO RNA: TRANSCRIPTION

DNA is housed within the nucleus, and protein synthesis takes place in the cytoplasm, thus there must be some sort of intermediate messenger that leaves the nucleus and manages protein synthesis. This intermediate messenger is messenger RNA (mRNA), a single-stranded nucleic acid that carries a copy of the genetic code for a single gene out of the nucleus and into the cytoplasm where it is used to produce proteins.

There are several different types of RNA, each having different functions in the cell. The structure of RNA is similar to DNA with a few small exceptions. For one thing, unlike DNA, most types of RNA, including mRNA, are single-stranded and contain no complementary strand. Second, the ribose sugar in RNA contains an additional oxygen atom compared with DNA. Finally, instead of the base thymine, RNA contains the base uracil. This means that adenine will always pair up with uracil during the protein synthesis process.

Gene expression begins with the process called transcription, which is the synthesis of a strand of mRNA that is complementary to the gene of interest. This process is called transcription because the mRNA is like a transcript, or copy, of the gene's DNA code. Transcription begins in a fashion somewhat like DNA replication, in that a region of DNA unwinds and the two strands separate, however, only that small portion of the DNA will be split apart. The triplets within the gene on this section of the DNA molecule are used as the template to transcribe the complementary strand of RNA (Figure 2). A codon is a three-base sequence of mRNA, so-called because they directly encode amino acids. Like DNA replication, there are three stages to transcription: initiation, elongation, and termination.

In this diagram, RNA polymerase is shown transcribing a DNA template strand into its corresponding RNA transcript.

Figure 2. Transcription: from DNA to mRNA. In the first of the two stages of making protein from DNA, a gene on the DNA molecule is transcribed into a complementary mRNA molecule.

Stage 1: Initiation. A region at the beginning of the gene called a promoter—a particular sequence of nucleotides—triggers the start of transcription.

Stage 2: Elongation. Transcription starts when RNA polymerase unwinds the DNA segment. One strand, referred to as the coding strand, becomes the template with the genes to be coded. The polymerase then aligns the correct nucleic acid (A, C, G, or U) with its complementary base on the coding strand of DNA. RNA polymerase is an enzyme that adds new nucleotides to a growing strand of RNA. This process builds a strand of mRNA.

Stage 3: Termination. When the polymerase has reached the end of the gene, one of three specific triplets (UAA, UAG, or UGA) codes a "stop" signal, which triggers the enzymes to terminate transcription and release the mRNA transcript.

Before the mRNA molecule leaves the nucleus and proceeds to protein synthesis, it is modified in a number of ways. For this reason, it is often called a pre-mRNA at this stage. For example, your DNA, and thus complementary mRNA, contains long regions called non-coding regions that do not code for amino acids. Their function is still a mystery, but the process called splicing removes these non-coding regions from the pre-mRNA transcript (Figure 3). A spliceosome—a structure composed of various proteins and other molecules—attaches to the mRNA and "splices" or cuts out the non-coding regions. The removed segment of the transcript is called an intron. The remaining exons are pasted together. An exon is a segment of RNA that remains after splicing. Interestingly, some introns that are removed from mRNA are not always non-coding. When different coding regions of mRNA are spliced out, different variations of the protein will eventually result, with differences in structure and function. This process results in a much larger variety of possible proteins and protein functions. When the mRNA transcript is ready, it travels out of the nucleus and into the cytoplasm.

In this diagram, a pre-mRNA transcript is shown in the top of a flowchart. This pre-mRNA transcript contains introns and exons. In the next step, the intron is in a structure called the spliceosome. In the last step, the intron is shown separated from the spliced RNA.

Figure 3. Splicing DNA. In the nucleus, a structure called a spliceosome cuts out introns (noncoding regions) within a pre-mRNA transcript and reconnects the exons.

FROM RNA TO PROTEIN: TRANSLATION

Like translating a book from one language into another, the codons on a strand of mRNA must be translated into the amino acid alphabet of proteins. Translation is the process of synthesizing a chain of amino acids called a polypeptide. Translation requires two major aids: first, a "translator," the molecule that will conduct the translation, and second, a substrate on which the mRNA strand is translated into a new protein, like the translator's "desk." Both of these requirements are fulfilled by other types of RNA. The substrate on which translation takes place is the ribosome.

Remember that many of a cell's ribosomes are found associated with the rough ER, and carry out the synthesis of proteins destined for the Golgi apparatus. Ribosomal RNA (rRNA) is a type of RNA that, together with proteins, composes the structure of the ribosome. Ribosomes exist in the cytoplasm as two distinct components, a small and a large subunit. When an mRNA molecule is ready to be translated, the two subunits come together and attach to the mRNA. The ribosome provides a substrate for translation, bringing together and aligning the mRNA molecule with the molecular "translators" that must decipher its code.

The other major requirement for protein synthesis is the translator molecules that physically "read" the mRNA codons. Transfer RNA (tRNA) is a type of RNA that ferries the appropriate corresponding amino acids to the ribosome, and attaches each new amino acid to the last, building the polypeptide chain one-by-one. Thus tRNA transfers specific amino acids from the cytoplasm to a growing polypeptide. The tRNA molecules must be

able to recognize the codons on mRNA and match them with the correct amino acid. The tRNA is modified for this function. On one end of its structure is a binding site for a specific amino acid. On the other end is a base sequence that matches the codon specifying its particular amino acid. This sequence of three bases on the tRNA molecule is called an anticodon. For example, a tRNA responsible for shuttling the amino acid glycine contains a binding site for glycine on one end. On the other end it contains an anticodon that complements the glycine codon (GGA is a codon for glycine, and so the tRNAs anticodon would read CCU). Equipped with its particular cargo and matching anticodon, a tRNA molecule can read its recognized mRNA codon and bring the corresponding amino acid to the growing chain (Figure 4).

The top part of this figure shows a large ribosomal subunit coming into contact with the mRNA that already has the small ribosomal subunit attached. A tRNA and an anticodon are in proximity. In the second panel, the tRNA also binds to the same site as the ribosomal subunits. In the bottom panel, a polypeptide chain is shown emerging from the complex.

Figure 4. Translation from RNA to Protein. During translation, the mRNA transcript is "read" by a functional complex consisting of the ribosome and tRNA molecules. tRNAs bring the appropriate amino acids in sequence to the growing polypeptide chain by matching their anti-codons with codons on the mRNA strand.

Much like the processes of DNA replication and transcription, translation consists of three main stages: initiation, elongation, and termination. Initiation takes place with the binding of a ribosome to an mRNA transcript. The elongation stage involves the recognition of a tRNA anticodon with the next mRNA codon in the sequence. Once the anticodon and codon sequences are bound (remember, they are complementary base pairs), the tRNA presents its amino acid cargo and the growing polypeptide strand is attached to this next amino acid. This attachment takes place with the assistance of various enzymes and requires energy. The tRNA molecule then releases the mRNA strand, the mRNA strand shifts one codon over in the ribosome, and the next appropriate tRNA arrives with its matching anticodon. This process continues until the final codon on the mRNA is reached which provides a "stop" message that signals termination of translation and triggers the release of the complete, newly synthesized protein. Thus, a gene within the DNA molecule is transcribed into mRNA, which is then translated into a protein product (Figure 5).

This figure shows a schematic of a cell where transcription from DNA to mRNA takes place inside the nucleus and translation from mRNA to protein takes place in the cytoplasm.

Figure 5. From DNA to Protein: Transcription through Translation. Transcription within the cell nucleus produces an mRNA molecule, which is modified and then sent into the cytoplasm for translation. The transcript is decoded into a protein with the help of a ribosome and tRNA molecules.

Commonly, an mRNA transcription will be translated simultaneously by several adjacent ribosomes. This increases the efficiency of protein synthesis. A single ribosome might translate an mRNA molecule in approximately one minute; so multiple ribosomes aboard

a single transcript could produce multiple times the number of the same protein in the same minute. A polyribosome is a string of ribosomes translating a single mRNA strand.

4. Describe the structure and function of mitochondria.

Ans: Mitochondria - Turning on the Powerhouse

Mitochondria are known as the powerhouses of the cell. They are organelles that act like a digestive system which takes in nutrients, breaks them down, and creates energy rich molecules for the cell. The biochemical processes of the cell are known as cellular respiration. Many of the reactions involved in cellular respiration happen in the mitochondria. Mitochondria are the working organelles that keep the cell full of energy.

Mitochondria are small organelles floating free throughout the cell. Some cells have several thousand mitochondria while others have none. Muscle cells need a lot of energy so they have loads of mitochondria. Neurons (cells that transmit nerve impulses) don't need as many. If a cell feels it is not getting enough energy to survive, more mitochondria can be created. Sometimes a mitochondrion can grow larger or combine with other mitochondria. It all depends on the needs of the cell.

Mitochondria Structure

Cross-section of a mitochondrion. Membranes, Matrix.Mitochondria are shaped perfectly to maximize their productivity. They are made of two membranes. The outer membrane covers the organelle and contains it like a skin. The inner membrane folds over many times and creates layered structures called cristae. The fluid contained in the mitochondria is called the matrix.

The folding of the inner membrane increases the surface area inside the organelle. Since many of the chemical reactions happen on the inner membrane, the increased surface area creates more space for reactions to occur. If you have more space to work, you can get more work done. Similar surface area strategies are used by microvilli in your intestines.

What's in the matrix? It's not liked the movies at all. Mitochondria are special because they have their own ribosomes and DNA floating in the matrix. There are also structures called granules which may control concentrations of ions. Cell biologists are still exploring the activity of granules.

Using Oxygen to Release Energy

How does cellular respiration occur in mitochondria? The matrix is filled with water and proteins (enzymes). Those proteins take organic molecules, such as pyruvate and acetyl CoA, and chemically digest them. Proteins embedded in the inner membrane and enzymes involved in the citric acid cycle ultimately release water (H_2O) and carbon dioxide (CO_2) molecules from the breakdown of oxygen (O_2) and glucose ($C_6H_{12}O_6$). The mitochondria are the only places in the cell where oxygen is reduced and eventually broken down into water.

Mitochondria are also involved in controlling the concentration of calcium (Ca^{2+}) ions within the cell. They work very closely with the endoplasmic reticulum to limit the amount of calcium in the cytosol.

5. Give the structure and function of RBC.

Ans: Red blood cells, also called erythrocytes, are the most abundant cell type in the blood. Other major blood components include plasma, white blood cells, and platelets. The primary function of red blood cells is to transport oxygen to body cells and deliver carbon dioxide to the lungs.

A red blood cell has what is known as a biconcave shape. Both sides of the cell's surface curve inward like the interior of a sphere. This shape aids in a red blood cell's ability to maneuver through tiny blood vessels to deliver oxygen to organs and tissues.

Red blood cells are also important in determining human blood type. Blood type is determined by the presence or absence of certain identifiers on the surface of red blood cells. These identifiers, also called antigens, help the body's immune system to recognize its own red blood cell type.

Red Blood Cell Structure

Erythrocytes have a large surface for gas exchange and high elasticity to navigate through capillary vessels.

Red blood cells have a unique structure. Their flexible disc shape helps to increase the surface area-to-volume ratio of these extremely small cells. This enables oxygen and carbon dioxide to diffuse across the red blood cells plasma membrane more readily. Red blood cells contain enormous amounts of a protein called hemoglobin. This iron-containing molecule binds oxygen as oxygen molecules enter blood vessels in the lungs. Hemoglobin is also responsible for the characteristic red color of blood.

Unlike other cells of the body, mature red blood cells do not contain a nucleus, mitochondria, or ribosomes. The absence of these cell structures leaves room for the hundreds of millions of hemoglobin molecules found in red blood cells. A mutation in the hemoglobin gene can result in the development of sickle-shaped cells and lead to sickle cell disorder.

Red Blood Cell Production

Bone Marrow, scanning electron micrograph (SEM). Bone marrow is where blood cell production takes place.

Red blood cells are derived from stem cells in red bone marrow. New red blood cell production, also called erythropoiesis, is triggered by low levels of oxygen in the blood. Low oxygen levels can occur for various reasons including blood loss, presence in high altitude, exercise, bone marrow damage, and low hemoglobin levels.

When the kidneys detect low oxygen levels, they produce and release a hormone called erythropoietin. Erythropoietin stimulates the production of red blood cells by red bone marrow. As more red blood cells enter blood circulation, oxygen levels in the blood and tissues increase. When the kidneys sense the increase in oxygen levels in the blood, they slow the release of erythropoietin. As a result, red blood cell production decreases.

Red blood cells circulate on average for about four months. Adults have around 25 trillion red blood cells in circulation at any given time. Due to their lack of a nucleus and other organelles, adult red blood cells cannot undergo mitosis to divide or generate new cell structures. When they become old or damaged, the vast majority of red blood cells are removed from circulation by the spleen, liver, and lymph nodes. These organs and tissues contain white blood cells called macrophages that engulf and digest damaged or dying

blood cells. Red blood cell degradation and erythropoiesis typically occur at the same rate to ensure homeostasis in red blood cell circulation.

Red Blood Cells and Gas Exchange

Alveoli

Alveoli in the human lung. Red blood cells flowing over the alveoli pick up oxygen, which is then carried to other parts of the body.

Gas exchange is the primary function of red blood cells. The process by which organisms exchange gases between their body cells and the environment is called respiration. Oxygen and carbon dioxide are transported through the body via the cardiovascular system. As the heart circulates blood, oxygen-depleted blood returning to the heart is pumped to the lungs. Oxygen is obtained as a result of respiratory system activity.

In the lungs, pulmonary arteries form smaller blood vessels called arterioles. Arterioles direct blood flow to the capillaries surrounding lung alveoli. Alveoli are the respiratory surfaces of the lungs. Oxygen diffuses across the thin endothelium of the alveoli sacs into the blood within the surrounding capillaries. Hemoglobin molecules in red blood cells release the carbon dioxide picked up from body tissues and become saturated with oxygen. Carbon dioxide diffuses from the blood to the alveoli, where it is expelled through exhalation.

The now oxygen-rich blood is returned to the heart and pumped to the rest of the body. As the blood reaches systemic tissues, oxygen diffuses from the blood to surrounding cells. Carbon dioxide produced as a result of cellular respiration diffuses from the interstitial fluid surrounding body cells into the blood. Once in the blood, carbon dioxide is bound by hemoglobin and returned to the heart via the cardiac cycle.

Red Blood Cell Disorders

Sickel Cell Anemia

This image shows a healthy red blood cell (left) and a sickle cell (right).

Diseased bone marrow can produce abnormal red blood cells. These cells may be irregular in size (too large or too small) or shape (sickle-shaped). Anemia is a condition characterized by the lack of production of new or healthy red blood cells. This means that there are not enough functioning red blood cells to carry oxygen to body cells. As a result, individuals with anemia may experience fatigue, dizziness, shortness of breath, or heart palpitations. Causes of anemia include sudden or chronic blood loss, not enough red blood cell production, and the destruction of red blood cells. Types of anemia include:

Aplastic anemia: A rare condition in which insufficient new blood cells are produced by bone marrow due to stem cell damage. Development of this condition is associated with a number of different factors including pregnancy, exposure to toxic chemicals, the side effect of certain medications, and certain viral infections, such as HIV, hepatitis, or Epstein-Barr virus.

Iron-deficiency anemia: A lack of iron in the body leads to insufficient red blood cell production. Causes include sudden blood loss, menstruation, and insufficient iron intake or absorption from food.

Sickle cell anemia: This inherited disorder is caused by a mutation in the hemoglobin gene that causes red blood cells to take on a sickle shape. These abnormally shaped cells get stuck in blood vessels, blocking normal blood flow.

Normocytic anemia: This condition results from a lack of red blood cell production. The cells that are produced, however, are of normal size and shape. This condition may result from kidney disease, bone marrow dysfunction, or other chronic diseases.
Hemolytic anemia: Red blood cells are prematurely destroyed, typically as a result of an infection, autoimmune disorder, or blood cancer.
Treatments for anemia vary based on severity and include iron or vitamin supplements, medication, blood transfusion, or bone marrow transplantation.

6. Write a note on WBC.

Ans: White blood cells (WBCs), also called leukocytes or leucocytes, are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders. All white blood cells are produced and derived from multipotent cells in the bone marrow known as hematopoietic stem cells. Leukocytes are found throughout the body, including the blood and lymphatic system.
All white blood cells have nuclei, which distinguishes them from the other blood cells, the anucleated red blood cells (RBCs) and platelets. The different white blood cell types are classified in standard ways; two pairs of broadest categories classify them either by structure (granulocytes or agranulocytes) or by cell lineage (myeloid cells or lymphoid cells). These broadest categories can be further divided into the five main types: neutrophils, eosinophils (acidophiles), basophils, lymphocytes, and monocytes. These types are distinguished by their physical and functional characteristics. Monocytes and neutrophils are phagocytic. Further subtypes can be classified; for example, among lymphocytes, there are B cells (named from bursa or bone marrow cells), T cells (named from thymus cells), and natural killer cells.
The number of leukocytes in the blood is often an indicator of disease, and thus the white blood cell count is an important subset of the complete blood count. The normal white cell count is usually between 4 × 109/L and 1.1 × 1010/L. In the US, this is usually expressed as 4,000 to 11,000 white blood cells per microliter of blood.[3] White blood cells make up approximately 1% of the total blood volume in a healthy adult,[4] making them substantially less numerous than the red blood cells at 40% to 45%. However, this 1% of the blood makes a large difference to health, because immunity depends on it. An increase in the number of leukocytes over the upper limits is called leukocytosis. It is normal when it is part of healthy immune responses, which happen frequently. It is occasionally abnormal, when it is neoplastic or autoimmune in origin. A decrease below the lower limit is called leukopenia. This indicates a weakened immune system.

Types:

All white blood cells are nucleated, which distinguishes them from the anucleated red blood cells and platelets. Types of leukocytes can be classified in standard ways. Two pairs of broadest categories classify them either by structure (granulocytes or agranulocytes) or by cell lineage (myeloid cells or lymphoid cells). These broadest categories can be further divided into the five main types: neutrophils, eosinophils, basophils, lymphocytes, and monocytes. These types are distinguished by their physical and functional characteristics. Monocytes and neutrophils are phagocytic. Further subtypes can be classified.

Granulocytes are distinguished from agranulocytes by their nucleus shape (lobed versus round, that is, polymorphonuclear versus mononuclear) and by their cytoplasm granules (present or absent, or more precisely, visible on light microscopy or not thus visible). The other dichotomy is by lineage: Myeloid cells (neutrophils, monocytes, eosinophils and basophils) are distinguished from lymphoid cells (lymphocytes) by hematopoietic lineage (cellular differentiation lineage). Lymphocytes can be further classified as T cells, B cells, and natural killer cells.

7. Write a note on platelets

Ans: Platelets, also known as thrombocytes, are blood cells responsible for blood clotting. If a blood vessel wall becomes damaged, platelets will rush to the site of injury and form a plug or clot to stop the bleeding. If platelet count is low (a condition called thrombocytopenia), the risk of uncontrolled or prolonged bleeding increases. When there are too many platelets in the blood (a condition called thrombocytosis), it may lead to abnormal blood clot formation, which can be serious and life-threatening.

Your doctor can help you assess your platelet count by looking at a complete blood count (CBC) test.

The root thrombo in thrombocyte means clot. You'll see it used with diseases and conditions that affect platelets and blood clotting.

What Platelets Do

Platelets are one of three types of blood cells (in addition to red blood cells and white blood cells) that originate in the bone marrow from cells known as megakaryocytes.

The process by which platelets form a clot is called adhesion.1 For example, if you accidentally cut your finger and rupture a blood vessel, it will start to bleed. In order to stop the bleeding, platelets within that broken vessel adhere to the site of injury and send out chemical signals for more help.

More platelets answer the call and begin to connect to each other to form a plug in a process called aggregation1. Once a plug or clot is formed in the blood vessel wall, the clotting (coagulation) cascade is activated, which then adds fibrin (a structural protein) to the clot to knit it together. Fibrin is responsible for the scab you may see at a cut site.

Aspirin and some non-steroidal anti-inflammatory drugs inhibit normal platelet function, which is why you may be asked to stop using them for a period of time before a surgery or procedure.

An Overview of Platelet Disorders

Testing and Your Platelets

An overview of the numbers, size, and health of platelets is included in a complete blood count (CBC) test, a standard lab panel of bloodwork that analyzes the makeup and chemistry of blood.

The specific lab markers that refer to platelets are as follows

Platelet Count (PLT)

Just as it sounds, this is the actual number of platelets you have (per microliter of blood).

- Low range: Less than 150,000 platelets per microliter
- Normal range: 150,000 to 450,000 platelets per microliter1

- Elevated range: 500,000 to 1,000,000 platelets per microliter

If your platelet count falls below 50,000, you may experience prolonged bleeding times.

Platelet count is an important number for your doctor to know before and after surgery to predict any potential bleeding and clotting problems. It is also an important marker during chemotherapy and radiation therapy, as these treatments may inhibit the production of platelets in the bone marrow.

Mean Platelet Volume (MPV)

The mean platelet volume (MPV) is the average size of the platelets. Younger platelets are larger than older ones, so an elevated number means you are producing and releasing them rapidly, while a low number means altered production in the bone marrow.

Platelets are live in the bloodstream for about eight to 10 days.1

Platelet Distribution Width (PDW)

PDW is the variation in the size of the platelets, which can indicate conditions that affect the platelets.

Platelet function tests may also be performed if there are symptoms of or potential for excessive bleeding, and to also monitor anti-platelet medications.

Understanding CBC Results

Causes of Low Platelet Count

If the body doesn't have enough platelets in circulation, you may develop a condition called thrombocytopenia.

The following factors may contribute to low platelet count:2

Chemotherapy or radiation therapy: These treatments suppress or kill off the blood-producing cells (megakaryocytes) in your bone marrow, leading to low platelet production.

Viral infections: Hepatitis C or HIV infections may attack bone marrow, affecting thrombocyte production.

Autoimmune conditions, such as lupus or immune thrombocytopenic purpura

Pregnancy: Hemolysis, elevated liver enzymes, low platelet count syndrome, better known as HELLP, in pregnancy is a variant of pre-eclampsia and may result in the breakdown of blood cells and platelets.

Medications: Anticoagulants such as warfarin and heparin may inhibit platelet production.

Other examples of conditions that may cause thrombocytopenia include having a mechanical heart valve, heparin antibodies, chronic alcohol abuse, liver disease, severe sepsis, and toxic exposures.

A platelet counts below 20,000 per microliter is a life-threatening risk as spontaneous bleeding may occur and be hard to stop. At that level, you may be given a platelet transfusion.

Understanding Thrombocytopenia

Causes of High Platelet Count

If the body has too many platelets in circulation, you may develop a condition called thrombocytosis.

The following factors may contribute to high platelet count:3

Primary bone marrow disorder: Essential thrombocytosis is a condition in which the megakaryocytes in bone marrow produce too many platelets, increasing the risk of blood clots.
Chronic inflammation in the body: Inflammatory conditions such as rheumatoid arthritis (RA) and inflammatory bowel disease (IBD) may result in elevated platelet counts as high levels of inflammation may cause the bone marrow to produce more white blood cells and platelets to combat cellular damage.
Infection: Bone marrow cells increase production of white blood cells and platelets to help fight infection, causing an elevation in platelet count.
Iron deficiency anemia: Reactive or secondary thrombocytosis may result when the body is undergoing a breakdown of red blood cells and the bone marrow cells go into overproduction to meet needs.
Spleen removal: Up to one-third of platelets are stored in the spleen at any time, and so removal of this organ will cause an increase in platelet concentration in the bloodstream. This is generally a temporary condition, however.
Cancer: High platelet counts can also be seen in cancer, especially with gastrointestinal cancer, as well as lymphoma, lung, ovarian, and breast cancer. This is thought to be due to the inflammation associated with the malignancy stimulating the production of platelets in the bone marrow.
In addition, a temporary increase in the platelet count can happen after major surgery or trauma.

8. Describe the blood clotting mechanism.

Ans: Coagulation, also known as clotting, is the process by which blood changes from a liquid to a gel, forming a blood clot. It potentially results in hemostasis, the cessation of blood loss from a damaged vessel, followed by repair. The mechanism of coagulation involves activation, adhesion and aggregation of platelets, as well as deposition and maturation of fibrin.
Coagulation begins almost instantly after an injury to the blood vessel has damaged the endothelium lining the blood vessel. Exposure of blood to the subendothelial space initiates two processes: changes in platelets, and the exposure of subendothelial tissue factor to plasma factor VII, which ultimately leads to cross-linked fibrin formation. Platelets immediately form a plug at the site of injury; this is called primary hemostasis. Secondary hemostasis occurs simultaneously: additional coagulation (clotting) factors beyond factor VII (listed below) respond in a cascade to form fibrin strands, which strengthen the platelet plug.
Disorders of coagulation are disease states which can result in hemorrhage, bruising, or thrombosis.
Coagulation is highly conserved throughout biology. In all mammals, coagulation involves both a cellular (platelet) and a protein (coagulation factor) component. The system in humans has been the most extensively researched and is the best understood.

Physiology

The interaction of vWF and GP1b alpha. The GP1b receptor on the surface of platelets allows the platelet to bind to vWF, which is exposed upon damage to vasculature. The vWF A1 domain (yellow) interacts with the extracellular domain of GP1ba (blue).

Platelet activation

When the endothelium is damaged, the normally isolated, underlying collagen is exposed to circulating platelets, which bind directly to collagen with collagen-specific glycoprotein Ia/IIa surface receptors. This adhesion is strengthened further by von Willebrand factor (vWF), which is released from the endothelium and from platelets; vWF forms additional links between the platelets' glycoprotein Ib/IX/V and A1 domain. This localization of platelets to the extracellular matrix promotes collagen interaction with platelet glycoprotein VI. Binding of collagen to glycoprotein VI triggers a signaling cascade that results in activation of platelet integrins. Activated integrins mediate tight binding of platelets to the extracellular matrix. This process adheres platelets to the site of injury.

Activated platelets release the contents of stored granules into the blood plasma. The granules include ADP, serotonin, platelet-activating factor (PAF), vWF, platelet factor 4, and thromboxane A2 (TXA2), which, in turn, activate additional platelets. The granules' contents activate a Gq-linked protein receptor cascade, resulting in increased calcium concentration in the platelets' cytosol. The calcium activates protein kinase C, which, in turn, activates phospholipase A2 (PLA2). PLA2 then modifies the integrin membrane glycoprotein IIb/IIIa, increasing its affinity to bind fibrinogen. The activated platelets change shape from spherical to stellate, and the fibrinogen cross-links with glycoprotein IIb/IIIa aid in aggregation of adjacent platelets (completing primary hemostasis).

Coagulation cascade

The classical blood coagulation pathway

The coagulation cascade of secondary hemostasis has two initial pathways which lead to fibrin formation. These are the contact activation pathway (also known as the intrinsic pathway), and the tissue factor pathway (also known as the extrinsic pathway), which both lead to the same fundamental reactions that produce fibrin. It was previously thought that the two pathways of coagulation cascade were of equal importance, but it is now known that the primary pathway for the initiation of blood coagulation is the tissue factor (extrinsic) pathway. The pathways are a series of reactions, in which a zymogen (inactive enzyme precursor) of a serine protease and its glycoprotein co-factor are activated to become active components that then catalyze the next reaction in the cascade, ultimately resulting in cross-linked fibrin. Coagulation factors are generally indicated by Roman numerals, with a lowercase a appended to indicate an active form.

The coagulation factors are generally serine proteases (enzymes), which act by cleaving downstream proteins. The exceptions are tissue factor, FV, FVIII, FXIII.[8] Tissue factor, FV and FVIII are glycoproteins, and Factor XIII is a transglutaminase.[7] The coagulation factors circulate as inactive zymogens. The coagulation cascade is therefore classically divided into three pathways. The tissue factor and contact activation pathways both activate the "final common pathway" of factor X, thrombin and fibrin.

Tissue factor pathway (extrinsic)

The main role of the tissue factor pathway is to generate a "thrombin burst", a process by which thrombin, the most important constituent of the coagulation cascade in terms of its feedback activation roles, is released very rapidly. FVIIa circulates in a higher amount than any other activated coagulation factor.

The process includes the following steps:

Following damage to the blood vessel, FVII leaves the circulation and comes into contact with tissue factor (TF) expressed on tissue-factor-bearing cells (stromal fibroblasts and leukocytes), forming an activated complex (TF-FVIIa).

TF-FVIIa activates FIX and FX.

FVII is itself activated by thrombin, FXIa, FXII and FXa.

The activation of FX (to form FXa) by TF-FVIIa is almost immediately inhibited by tissue factor pathway inhibitor (TFPI).

FXa and its co-factor FVa form the prothrombinase complex, which activates prothrombin to thrombin.

Thrombin then activates other components of the coagulation cascade, including FV and FVIII (which forms a complex with FIX), and activates and releases FVIII from being bound to vWF.

FVIIIa is the co-factor of FIXa, and together they form the "tenase" complex, which activates FX; and so the cycle continues. ("Tenase" is a contraction of "ten" and the suffix "-ase" used for enzymes.)

Contact activation pathway (intrinsic)

The contact activation pathway begins with formation of the primary complex on collagen by high-molecular-weight kininogen (HMWK), prekallikrein, and FXII (Hageman factor). Prekallikrein is converted to kallikrein and FXII becomes FXIIa. FXIIa converts FXI into FXIa. Factor XIa activates FIX, which with its co-factor FVIIIa form the tenase complex, which activates FX to FXa. The minor role that the contact activation pathway has in initiating clot formation can be illustrated by the fact that patients with severe deficiencies of FXII, HMWK, and prekallikrein do not have a bleeding disorder. Instead, contact activation system seems to be more involved in inflammation, and innate immunity. Despite this, interference with the pathway may confer protection against thrombosis without a significant bleeding risk.

Final common pathway

The division of coagulation in two pathways is arbitrary, originating from laboratory tests in which clotting times were measured either after the clotting was initiated by glass, the intrinsic pathway; or clotting was initiated by thromboplastin (a mix of tissue factor and phospholipids), the extrinsic pathway.

Further, the final common pathway scheme implies that prothrombin is converted to thrombin only when acted upon by the intrinsic or extrinsic pathways, which is an oversimplification. In fact, thrombin is generated by activated platelets at the initiation of the platelet plug, which in turn promotes more platelet activation.

Thrombin functions not only to convert fibrinogen to fibrin, it also activates Factors VIII and V and their inhibitor protein C (in the presence of thrombomodulin); and it activates Factor XIII, which forms covalent bonds that crosslink the fibrin polymers that form from activated monomers.

The coagulation cascade is maintained in a prothrombotic state by the continued activation of FVIII and FIX to form the tenase complex until it is down-regulated by the anticoagulant pathways.

Cell-based scheme of coagulation

A newer model of coagulation mechanism explains the intricate combination of cellular and biochemical events that occur during the coagulation process in vivo. Along with the procoagulant and anticoagulant plasma proteins, normal physiologic coagulation requires the presence of two cell types for formation of coagulation complexes: cells that express tissue factor (usually extravascular) and platelets.

The coagulation process occurs in two phases. First is the initiation phase, which occurs in tissue-factor-expressing cells. This is followed by the propagation phase, which occurs on activated platelets. The initiation phase, mediated by the tissue factor exposure, proceeds via the classic extrinsic pathway and contributes to about 5% of thrombin production. The amplified production of thrombin occurs via the classic intrinsic pathway in the propagation phase; about 95% of thrombin generated will be during this second phase.

Cofactors

Various substances are required for the proper functioning of the coagulation cascade:

Calcium and phospholipid

Calcium and phospholipid (a platelet membrane constituent) are required for the tenase and prothrombinase complexes to function. Calcium mediates the binding of the complexes via the terminal gamma-carboxy residues on FXa and FIXa to the phospholipid surfaces expressed by platelets, as well as procoagulant microparticles or microvesicles shed from them. Calcium is also required at other points in the coagulation cascade.

Vitamin K

Vitamin K is an essential factor to a hepatic gamma-glutamyl carboxylase that adds a carboxyl group to glutamic acid residues on factors II, VII, IX and X, as well as Protein S, Protein C and Protein Z. In adding the gamma-carboxyl group to glutamate residues on the immature clotting factors, Vitamin K is itself oxidized. Another enzyme, Vitamin K epoxide reductase (VKORC), reduces vitamin K back to its active form. Vitamin K epoxide reductase is pharmacologically important as a target of anticoagulant drugs warfarin and related coumarins such as acenocoumarol, phenprocoumon, and dicumarol. These drugs create a deficiency of reduced vitamin K by blocking VKORC, thereby inhibiting maturation of clotting factors. Vitamin K deficiency from other causes (e.g., in malabsorption) or impaired vitamin K metabolism in disease (e.g., in liver failure) lead to the formation of PIVKAs (proteins formed in vitamin K absence), which are partially or totally non-gamma carboxylated, affecting the coagulation factors' ability to bind to phospholipid.

Regulators

Coagulation with arrows for negative and positive feedback.

Five mechanisms keep platelet activation and the coagulation cascade in check. Abnormalities can lead to an increased tendency toward thrombosis:

Protein C

Protein C is a major physiological anticoagulant. It is a vitamin K-dependent serine protease enzyme that is activated by thrombin into activated protein C (APC). Protein C is activated in a sequence that starts with Protein C and thrombin binding to a cell surface protein thrombomodulin. Thrombomodulin binds these proteins in such a way that it activates Protein C. The activated form, along with protein S and a phospholipid as cofactors, degrades FVa and FVIIIa. Quantitative or qualitative deficiency of either (protein C or protein S) may lead to thrombophilia (a tendency to develop thrombosis). Impaired action of Protein C (activated Protein C resistance), for example by having the "Leiden" variant of Factor V or high levels of FVIII, also may lead to a thrombotic tendency.

Antithrombin

Antithrombin is a serine protease inhibitor (serpin) that degrades the serine proteases: thrombin, FIXa, FXa, FXIa, and FXIIa. It is constantly active, but its adhesion to these factors is increased by the presence of heparan sulfate (a glycosaminoglycan) or the administration of heparins (different heparinoids increase affinity to FXa, thrombin, or both). Quantitative or qualitative deficiency of antithrombin (inborn or acquired, e.g., in proteinuria) leads to thrombophilia.

Tissue factor pathway inhibitor (TFPI)

Tissue factor pathway inhibitor (TFPI) limits the action of tissue factor (TF). It also inhibits excessive TF-mediated activation of FVII and FX.

Plasmin

Plasmin is generated by proteolytic cleavage of plasminogen, a plasma protein synthesized in the liver. This cleavage is catalyzed by tissue plasminogen activator (t-PA), which is synthesized and secreted by endothelium. Plasmin proteolytically cleaves fibrin into fibrin degradation products that inhibit excessive fibrin formation.

Prostacyclin

Prostacyclin (PGI2) is released by endothelium and activates platelet Gs protein-linked receptors. This, in turn, activates adenylyl cyclase, which synthesizes cAMP. cAMP inhibits platelet activation by decreasing cytosolic levels of calcium and, by doing so, inhibits the release of granules that would lead to activation of additional platelets and the coagulation cascade.

Fibrinolysis

Eventually, blood clots are reorganised and resorbed by a process termed fibrinolysis. The main enzyme responsible for this process (plasmin) is regulated by various activators and inhibitors.

Role in immune system

The coagulation system overlaps with the immune system. Coagulation can physically trap invading microbes in blood clots. Also, some products of the coagulation system can contribute to the innate immune system by their ability to increase vascular permeability and act as chemotactic agents for phagocytic cells. In addition, some of the products of the coagulation system are directly antimicrobial. For example, beta-lysine, an amino acid produced by platelets during coagulation, can cause lysis of many Gram-positive bacteria by acting as a cationic detergent. Many acute-phase proteins of inflammation are involved

in the coagulation system. In addition, pathogenic bacteria may secrete agents that alter the coagulation system, e.g. coagulase and streptokinase.

9. Write a note on lymph node.

A lymph node, or lymph gland is a kidney-shaped organ of the lymphatic system, and the adaptive immune system. A large number of lymph nodes are linked throughout the body by the lymphatic vessels. They are major sites of lymphocytes that include B and T cells. Lymph nodes are important for the proper functioning of the immune system, acting as filters for foreign particles including cancer cells, but have no detoxification function.

In the lymphatic system a lymph node is a secondary lymphoid organ. A lymph node is enclosed in a fibrous capsule and is made up of an outer cortex and an inner medulla.

Lymph nodes become inflamed or enlarged in various diseases, which may range from trivial throat infections to life-threatening cancers. The condition of lymph nodes is very important in cancer staging, which decides the treatment to be used and determines the prognosis. Lymphadenopathy refers to glands that are enlarged or swollen. When inflamed or enlarged, lymph nodes can be firm or tender.

Structure

Cross-section of a lymph node with sections labelled.

1) Capsule;
2) Subcapsular sinus;
3) Germinal center;
4) Lymphoid nodule;
5) Trabeculae

Lymph nodes are kidney or oval shaped and range in size from 0.1 to 2.5 cm long. Each lymph node is surrounded by a fibrous capsule, which extends inside a lymph node to form trabeculae. The substance of a lymph node is divided into the outer cortex and the inner medulla. These are rich with cells. The hilum is an indent on the concave surface of the lymph node where lymphatic vessels leave and blood vessels enter and leave.

Lymph enters the convex side of a lymph node through multiple afferent lymphatic vessels and from here flows into a series of sinuses. After entering the lymph node from afferent lymphatic vessels, lymph flows into a space underneath the capsule called the subcapsular sinus, then into cortical sinuses. After passing through the cortex, lymph then collects in medullary sinuses. All of these sinuses drain into the efferent lymph vessels to exit the node at the hilum on the concave side.

Location

Lymph nodes are present throughout the body, are more concentrated near and within the trunk, and are divided into groups. There are about 450 lymph nodes in the adult. Some lymph nodes can be felt when enlarged (and occasionally when not), such as the axillary lymph nodes under the arm, the cervical lymph nodes of the head and neck and the inguinal lymph nodes near the groin crease. Most lymph nodes lie within the trunk adjacent to other major structures in the body - such as the paraaortic lymph nodes and the tracheobronchial lymph nodes.

There are no lymph nodes in the central nervous system, which is separated from the body by the blood-brain barrier. Lymph from the meningeal lymphatic vessels in the CNS drains to the deep cervical lymph nodes.

Subdivisions

A lymph node is divided into compartments called nodules (or lobules), each consisting of a region of cortex with combined follicle B cells, a paracortex of T cells, and a part of the nodule in the medulla. The substance of a lymph node is divided into the outer cortex and the inner medulla. The cortex of a lymph node is the outer portion of the node, underneath the capsule and the subcapsular sinus. It has an outer part and a deeper part known as the paracortex. The outer cortex consists of groups of mainly inactivated B cells called follicles. When activated, these may develop into what is called a germinal centre. The deeper paracortex mainly consists of the T cells. Here the T-cells mainly interact with dendritic cells, and the reticular network is dense.

The medulla contains large blood vessels, sinuses and medullary cords that contain antibody-secreting plasma cells. There are less cells in the medulla.

The medullary cords are cords of lymphatic tissue, and include plasma cells, macrophages, and B cells.

Cells

In the lymphatic system a lymph node is a secondary lymphoid organ. Lymph nodes contain lymphocytes, a type of white blood cell, and are primarily made up of B cells and T cells. B cells are mainly found in the outer cortex where they are clustered together as follicular B cells in lymphoid follicles, and T cells and dendritic cells are mainly found in the paracortex.

There are fewer cells in the medulla than the cortex. The medulla contains plasma cells, as well as macrophages which are present within the medullary sinuses.

As part of the reticular network, there are follicular dendritic cells in the B cell follicle and fibroblastic reticular cells in the T cell cortex. The reticular network provides structural support and a surface for adhesion of the dendritic cells, macrophages and lymphocytes. It also allows exchange of material with blood through the high endothelial venules and provides the growth and regulatory factors necessary for activation and maturation of immune cells.

Afferent and efferent vessels

Lymph enters the convex side of a lymph node through multiple afferent lymphatic vessels, which form a network of lymphatic vessels (Latin: plexus) and from here flows into a space (Latin: sinus) underneath the capsule called the subcapsular sinus. From here, lymph flows into sinuses within the cortex. After passing through the cortex, lymph then collects in medullary sinuses. All of these sinuses drain into the efferent lymphatic vessels to exit the node at the hilum on the concave side.

These are channels within the node lined by endothelial cells along with fibroblastic reticular cells, allowing for the smooth flow of lymph. The endothelium of the subcapsular sinus is continuous with that of the afferent lymph vessel and also with that of the similar sinuses flanking the trabeculae and within the cortex. These vessels are smaller and don't allow the passage of macrophages so that they remain contained to

function within a lymph node. In the course of the lymph, lymphocytes may be activated as part of the adaptive immune response.

There is usually only one efferent vessel though sometimes there may be two. Medullary sinuses contain histiocytes (immobile macrophages) and reticular cells.

A lymph node contains lymphoid tissue, i.e., a meshwork or fibers called reticulum with white blood cells enmeshed in it. The regions where there are few cells within the meshwork are known as lymph sinus. It is lined by reticular cells, fibroblasts and fixed macrophages.

Capsule

Lymph node tissue showing trabeculae

Thin reticular fibers (reticulin) of reticular connective tissue form a supporting meshwork inside the node. The lymph node capsule is composed of dense irregular connective tissue with some plain collagenous fibers, and a number of membranous processes or trabeculae extend from its internal surface. The trabeculae pass inward, radiating toward the center of the node, for about one-third or one-fourth of the space between the circumference and the center of the node. In some animals they are sufficiently well-marked to divide the peripheral or cortical portion of the node into a number of compartments (nodules), but in humans this arrangement is not obvious. The larger trabeculae springing from the capsule break up into finer bands, and these interlace to form a mesh-work in the central or medullary portion of the node. These trabecular spaces formed by the interlacing trabeculae contain the proper lymph node substance or lymphoid tissue. The node pulp does not, however, completely fill the spaces, but leaves between its outer margin and the enclosing trabeculae a channel or space of uniform width throughout. This is termed the subcapsular sinus (lymph path or lymph sinus). Running across it are a number of finer trabeculae of reticular fibers, mostly covered by ramifying cells.

Function

In the lymphatic system a lymph node is a secondary lymphoid organ.

Diagram of a lymph node showing lymphocytes.

The primary function of lymph nodes is the filtering of lymph to identify and fight infection. In order to do this, lymph nodes contain lymphocytes, a type of white blood cell, which includes B cells and T cells. These circulate through the bloodstream and enter and reside in lymph nodes. B cells produce antibodies. Each antibody has a single predetermined target, an antigen, that it can bind to. These circulate throughout the bloodstream and if they find this target, the antibodies bind to it and stimulate an immune response. Each B cell produces different antibodies, and this process is driven in lymph nodes. B cells enter the bloodstream as "naive" cells produced in bone marrow. After entering a lymph node, they then enter a lymphoid follicle, where they multiply and divide, each producing a different antibody. If a cell is stimulated, it will go on to produce more antibodies (a plasma cell) or act as a memory cell to help the body fight future infection. If a cell is not stimulated, it will undergo apoptosis and die.

Antigens are molecules found on bacterial cell walls, chemical substances secreted from bacteria, or sometimes even molecules present in body tissue itself. These are taken up by cells throughout the body called antigen-presenting cells, such as dendritic cells. These antigen presenting cells enter the lymph system and then lymph nodes. They present the

antigen to T cells and, if there is a T cell with the appropriate T cell receptor, it will be activated.

B cells acquire antigen directly from the afferent lymph. If a B cell binds its cognate antigen it will be activated. Some B cells will immediately develop into antibody secreting plasma cells, and secrete IgM. Other B cells will internalize the antigen and present it to Follicular helper T cells on the B and T cell zone interface. If a cognate FTh cell is found it will upregulate CD40L and promote somatic hypermutation and isotype class switching of the B cell, increasing its antigen binding affinity and changing its effector function. Proliferation of cells within a lymph node will make the node expand.

Lymph is present throughout the body, and circulates through lymphatic vessels. These drain into and from lymph nodes – afferent vessels drain into nodes, and efferent vessels from nodes. When lymph fluid enters a node, it drains into the node just beneath the capsule in a space called the subcapsular sinus. The subcapsular sinus drains into trabecular sinuses and finally into medullary sinuses. The sinus space is crisscrossed by the pseudopods of macrophages, which act to trap foreign particles and filter the lymph. The medullary sinuses converge at the hilum and lymph then leaves the lymph node via the efferent lymphatic vessel towards either a more central lymph node or ultimately for drainage into a central venous subclavian blood vessel.

The B cells migrate to the nodular cortex and medulla.

The T cells migrate to the deep cortex. This is a region of a lymph node called the paracortex that immediately surrounds the medulla. Because both naive T cells and dendritic cells express CCR7, they are drawn into the paracortex by the same chemotactic factors, increasing the chance of T cell activation. Both B and T lymphocytes enter lymph nodes from circulating blood through specialized high endothelial venules found in the paracortex.

10. Write a structure and function of Spleen.

Ans: The spleen is an organ found in virtually all vertebrates. Similar in structure to a large lymph node, it acts primarily as a blood filter. The word spleen comes from Ancient Greek σπλήν (splḗn)

The spleen plays important roles in regard to red blood cells (erythrocytes) and the immune system. It removes old red blood cells and holds a reserve of blood, which can be valuable in case of hemorrhagic shock, and also recycles iron. As a part of the mononuclear phagocyte system, it metabolizes hemoglobin removed from senescent red blood cells (erythrocytes). The globin portion of hemoglobin is degraded to its constitutive amino acids, and the heme portion is metabolized to bilirubin, which is removed in the liver.

The spleen synthesizes antibodies in its white pulp and removes antibody-coated bacteria and antibody-coated blood cells by way of blood and lymph node circulation. These monocytes, upon moving to injured tissue (such as the heart after myocardial infarction), turn into dendritic cells and macrophages while promoting tissue healing. The spleen is a center of activity of the mononuclear phagocyte system and is analogous to a large lymph node, as its absence causes a predisposition to certain infections.

In humans the spleen is purple in color and is in the left upper quadrant of the abdomen.

11. **Give the composition and function of lymph.**

Composition of Lymph Composition of Lymph - Lymphoid Organs Lymph:

Lymph, derived from a Latin word, is a fluid which flows through the lymphatic system that is composed of lymph nodes and lymph vessels or channels. Lymph is formed when the intestinal fluid i.e. the fluid that lies in the interstices of all body tissues is gathered through lymph capillaries. Then it is elated through larger lymphatic vessels to lymph nodes, where materials are eliminated by lymphocytes, before unfilling eventually into the left and right subclavian vein, where it blends with the venous blood.

As the lymph is derived from the intestinal fluid, its composition frequently changes as the blood and the surrounding cells repeatedly swap over materials with the intestinal fluid. It is usually alike blood plasma, which is the fluid component of blood. Lymph returns proteins and also surplus intestinal fluid to the bloodstream.

Bacteria might pierce into lymph channels and could be transported to lymph nodes, where they will be destroyed. The lymphatic system plays a vital role in multicellular organisms since it is responsible for executing multiple interconnected functions. The lymphatic system comprises of various parts, which are engaged in various functions.

Functions of the intestinal fluids are as follows:

• Intestinal fluid is used for transporting nutrients to the cells.

• It is used to offer intercellular communication among the cells.

• It is also used in eliminating the metabolic wastes from the cells.

The essential quantity of intestinal fluid is gathered by the lymphatic system and the rest is exhausted out. The exhausted fluid return back into the major vein and the remaining fluid that is gathered through the lymph capillaries is known as lymph.

The composition of lymph:

• Lymph plasma:

Lymph plasma is like that of blood but has lesser number of calcium, blood proteins, the phosphorous and a high amount of glucose concentration. Mostly, globulin proteins that are present are in fact antibodies. Further components of the lymph plasma are very much similar to that of blood plasma, water, inorganic & organic substances, etc.

• Lymph corpuscles:

Lymph corpuscles are oating amoeboid cells, the white blood corpuscles (the leucocytes), which are typically lymphocytes. Red blood corpuscles (erythrocytes) and platelets are not present in lymph.

12. Write the structure and function of lymph node.

Ans: Lymphoid organs:

Lymphoid organs are the organs that secrete lymph. In addition of the lymph nodes, thymus gland, tonsils, spleen and Peyer's patches are the added lymphoid organs. In the body, the largest mass of lymphatic tissue is the spleen.

Functions of lymph:

1. Cells of the body are maintained moist by the lymph.

2. Lymphocytes are produced by lymph nodes. Lymph takes antibodies and lymphocytes from the lymph nodes to the blood.

3. Lymph destroys the attacking foreign particles and microorganisms in the lymph nodes.
4. It transports and absorbs fat-soluble vitamins and fat from the intestine. Villi are the lymphatic capillaries that are present in the intestinal villi.
5. It brings hormones made in the endocrine glands to the blood and plasma protein macromolecules manufactured in the liver cells.
6. It sustains the volume of the blood. Once the volume of the blood is reduced in the blood vascular system, the lymph hurries from the lymphatic system to the blood vascular system.

13. Explain the structure of blood vessels.

Ans: Blood vessels are key components of the systemic and pulmonary circulatory systems that distribute blood throughout the body. There are three major types of blood vessels: arteries that carry blood away from the heart, branching into smaller arterioles throughout the body and eventually forming the capillary network. The latter facilitates efficient chemical exchange between tissue and blood. Capillaries in turn merge into venules, then into larger veins responsible for returning the blood to the heart. The junctions between vessels are called anastomoses.

Arteries and veins are comprised of three distinct layers while the much smaller capillaries are composed of a single layer.

Tunica Intima

The inner layer (tunica intima) is the thinnest layer, formed from a single continuous layer of endothelial cells and supported by a subendothelial layer of connective tissue and supportive cells. In smaller arterioles or venules, this subendothelial layer consists of a single layer of cells, but can be much thicker in larger vessels such as the aorta. The tunica intima is surrounded by a thin membrane comprised of elastic fibers running parallel to the vessel. Capillaries consist only of the thin endothelial layer of cells with an associated thin layer of connective tissue.

Tunica Media

Surrounding the tunica intima is the tunica media, comprised of smooth muscle cells and elastic and connective tissues arranged circularly around the vessel. This layer is much thicker in arteries than in veins. Fiber composition also differs; veins contain fewer elastic fibers and function to control caliber of the arteries, a key step in maintaining blood pressure.

Tunica Externa

The outermost layer is the tunica externa or tunica adventitia, composed entirely of connective fibers and surrounded by an external elastic lamina which functions to anchor vessels with surrounding tissues. The tunica externa is often thicker in veins to prevent collapse of the blood vessel and provide protection from damage since veins may be superficially located.

A diagram of an artery showing the three layers of the blood vessel. The thin inner tunica intima, thick contractile tunica media and tough outher tunica externa.

Structure of the Artery Wall: This diagram of the artery wall indicates the smooth muscle, external elastic membrane, endothelium, internal elastic membrane, tunica externa, tunica media, and tunica intima.

Valve Function

A major structural difference between arteries and veins is the presence of valves. In arteries, the blood is pumped under pressure from the heart, so backflow cannot occur. However, passing through the capillary network results in a decrease in blood pressure, meaning that backflow of blood is possible in veins. To counteract this, veins contain numerous one-direction valves that prevent backflow.

Blood Vessel Function

Blood vessels carry nutrients and oxygen throughout the body and aid in gas exchange.

Blood plays many critical roles within the body: delivering nutrients and chemicals to tissues, removing waste products, and maintaining homeostasis and health. The circulatory system is transports blood through the body to perform these actions, facilitated by the extensive network of blood vessels.

Gas Transfer

The circulatory system can be split into two sections, systemic and pulmonary. In the systemic circulatory system, highly oxygenated blood (95-100%) is pumped from the left ventricle of the heart and into the arteries of the body. Upon reaching the capillary networks, gas exchange between tissue and blood can occur, facilitated by the narrow walls of the capillaries. Oxygen is released from the blood into the tissues and carbon dioxide, a waste product of respiration, is absorbed. The capillaries merge into venules and then veins, carrying the deoxygenated blood (~75%) back to the right atrium of the heart at the end of the systemic circulatory system.

The much smaller pulmonary system reoxygenates the blood and facilitates the removal of carbon dioxide. After leaving the heart through the right ventricle, the blood passes through the pulmonary artery, the only artery in the body that contains deoxygenated blood, and into the capillary network within the lungs. The close association of the thin-walled alveolae with the equally thin-walled capillaries allows for rapid release of carbon dioxide and uptake of oxygen. After leaving the lungs through the pulmonary vein, the only vein which carries oxygenated blood, the blood enters the left atrium. This completes the pulmonary circulatory system.

This diagram of the circulatory system indicates the basilar artery, internal and external carotid arteries, external and internal jugular veins, vertebral arteries, common carotid arteries, pulmonary arteries and veins, heart, celiac trunk, hepatic vein, renal veins, renal artery, gonadal vein, gonadal artery, common iliac vein and artery, internal iliac vein and artery, external iliac vein and artery, great saphenous vein, femoral vein and artery, popliteal vein and artery, small saphenous vein, anterior and posterior tibial arteries, peroneal artery, anterior and posterior tibial veins, dorsal venous arch, dorsal digital vein, arcuate artery, dorsal digital arteries, digital artery, palmar digital veins, radial artery, ulnar artery, cephalic vein, medial cubital vein, basilic vein, brachial artery, descending aorta, inferior and superior vena cava, aorta, axillary artery and vein, cephalic vein, and subclavian vein and artery.

The Circulatory System: This simplified diagram of the human circulatory system (anterior view) shows arteries in red and veins in blue.

Additional Functions

Blood vessels also facilitate the rapid distribution and efficient transport of factors such as glucose, amino acids, or lipids into the tissues and the removal of waste products for processing elsewhere, such as lactic acid to the liver or urea to the kidneys. Additionally, blood vessels provide the ideal network for immune system surveillance and distribution. Numerous white blood cells circulate around the body, sensing for infection or injury. Once an injury is detected, they rapidly leave the circulatory system by passing through gaps in vessel walls to reach the affected area while signaling for a larger targeted immune response.

Mechanically the blood vessels, especially those near the skin, play a key role in thermoregulation. Blood vessels can swell to allow greater blood flow, allowing for greater radiant heat loss. Conversely, blood flow through these vessels can be lessened to reduce heat loss in colder climates.

Artery Function

Arteries are high-pressure blood vessels that carry oxygenated blood away from the heart to all other tissues and organs.

Arteries are blood vessels that carry blood away from the heart under pressure. This blood is usually oxygenated, with the exception of that in the pulmonary artery, which carries deoxygenated blood to the lungs.

This diagram of the arterial system indicates the anterior, middle, and posterior cerebral arteries; basilar artery; internal and external carotid arteries; vertebral arteries; common carotid arteries; pulmonary veins; heart; intercostal arteries; left and right gastric arteries; celiac trunk; splenic artery; common hepatic artery; superior and inferior mesenteric artery; renal artery; testicularis artery; common, internal, and external iliac arteries; femoral circumflex artery; perforating branch; deep femoral artery; femoral artery; popliteal artery; dorsal metatarsal and digital arteries; arcuate artery; deep plantar arch; peroneal artery; posterior and anterior tibial artery; inferior, superior, and descending genicular arteries; descending branch of the femoral circumflex artery; digital artery; deep palmar arches; dorsal and palmar carpal arch; ulnar artery; radial artery; interosseous artery; inferior and superior epigastric artery; descending aorta; radial recurrent artery; deep brachial artery; brachial artery; internal thoracic artery; axillary artery; aortic arch; and subclavian artery.

Arterial system: Simplified diagram of the human arterial system in anterior view.

As with veins, arteries are comprised of three layers: the tunicae intima, media, and externa. In arteries, the tunica media, which contains smooth muscle cells and elastic tissue, is thicker than that of veins so it can modulate vessel caliber and thus control and maintain blood pressure.

Arterial pressure varies between the peak pressure during heart contraction, called the systolic pressure, and the minimum or diastolic pressure between contractions, when the heart expands and refills. This pressure variation within the artery produces the observable pulse that reflects heart activity. The pressure in the arterial system decreases

steadily, highest in the aorta and lowest in the venous system, as blood approaches the heart after delivery of oxygen to tissues in the systemic circulation.

Arteries of the systemic circulation can be subdivided into muscular or elastic types according to the the relative compositions of elastic and muscle tissue in their tunica media. Larger arteries are typically elastic and smaller arteries are more likely to be muscular. These arteries deliver blood to the arterioles, which in turn deliver blood to the capillary networks associated with the body's tissues.

Elastic Arteries

An elastic or conducting artery has a large number of collagen and elastin filaments in the tunica media.

Elastic arteries contain larger numbers of collagen and elastin filaments in their tunica media than muscular arteries do, giving them the ability to stretch in response to each pulse.

Elastic arteries include the largest arteries in the body, those closest to the heart, and give rise to the smaller muscular arteries. The pulmonary arteries, the aorta, and its branches together comprise the body's system of elastic arteries. In these large arteries, the amount of elastic tissue is considerable and the smooth muscle fiber cells are arranged in 5 to 7 layers in both circular and longitudinal directions.

This diagram of the arterial wall indicates the fibroblast, elastica interna, endothelial cells, lumen, smooth muscle cells, intima, media, and adventitia.

Anatomy of the Arterial Wall: Arterial wall layers including the tunica intima and the tunica media. In elastic arteries, the tunica media is rich with elastic and connective tissue.

This diagram of the aorta indicates the left and right common carotid arteries, left and right subclavian arteries, brachiocephalic artery, aortic arch, ascending and descending aorta, and right and left coronary arteries.

The aorta: The aorta makes up most of the elastic arteries in the body.

Arterial elasticity gives rise to the Windkessel effect, which through passive contraction after expansion helps to maintain a relatively constant pressure in the arteries despite the pulsating nature of the blood flow from the heart.

The Aorta

Due to position as the first part of the systemic circulatory system closest to the heart and the resultant high pressures it will experience, the aorta is perhaps the most elastic artery, featuring an incredibly thick tunica media rich in elastic filaments. The aorta is so thick that it requires its own capillary network to supply it with sufficient oxygen and nutrients to function, the vasa vasorum.

When the left ventricle contracts to force blood into the aorta, the aorta expands. This stretching generates the potential energy that will help maintain blood pressure during diastole, when the aorta contracts passively. Additionally, the elastic recoil helps conserve the energy from the pumping heart and smooth the flow of blood around the body through the Windkessel effect.

Muscular Arteries

Distributing arteries are medium-sized arteries that draw blood from an elastic artery and branch into resistance vessels.

14. Explain the structure of heart.

Ans: Structure of the Heart

The human heart is a four-chambered muscular organ, shaped and sized roughly like a man's closed fist with two-thirds of the mass to the left of midline.

The heart is enclosed in a pericardial sac that is lined with the parietal layers of a serous membrane. The visceral layer of the serous membrane forms the epicardium.

Layers of the Heart Wall

Three layers of tissue form the heart wall. The outer layer of the heart wall is the epicardium, the middle layer is the myocardium, and the inner layer is the endocardium.

Chambers of the Heart

The internal cavity of the heart is divided into four chambers:

Right atrium

Right ventricle

Left atrium

Left ventricle

The two atria are thin-walled chambers that receive blood from the veins. The two ventricles are thick-walled chambers that forcefully pump blood out of the heart. Differences in thickness of the heart chamber walls are due to variations in the amount of myocardium present, which reflects the amount of force each chamber is required to generate.

The right atrium receives deoxygenated blood from systemic veins; the left atrium receives oxygenated blood from the pulmonary veins.

Valves of the Heart

Pumps need a set of valves to keep the fluid flowing in one direction and the heart is no exception. The heart has two types of valves that keep the blood flowing in the correct direction. The valves between the atria and ventricles are called atrioventricular valves (also called cuspid valves), while those at the bases of the large vessels leaving the ventricles are called semilunar valves.

The right atrioventricular valve is the tricuspid valve. The left atrioventricular valve is the bicuspid, or mitral, valve. The valve between the right ventricle and pulmonary trunk is the pulmonary semilunar valve. The valve between the left ventricle and the aorta is the aortic semilunar valve.

When the ventricles contract, atrioventricular valves close to prevent blood from flowing back into the atria. When the ventricles relax, semilunar valves close to prevent blood from flowing back into the ventricles.

Pathway of Blood through the Heart

While it is convenient to describe the flow of blood through the right side of the heart and then through the left side, it is important to realize that both atria and ventricles contract at the same time. The heart works as two pumps, one on the right and one on the left, working simultaneously. Blood flows from the right atrium to the right ventricle, and then is pumped to the lungs to receive oxygen. From the lungs, the blood flows to the left atrium, then to the left ventricle. From there it is pumped to the systemic circulation.

Blood Supply to the Myocardium

The myocardium of the heart wall is a working muscle that needs a continuous supply of oxygen and nutrients to function efficiently. For this reason, cardiac muscle has an extensive network of blood vessels to bring oxygen to the contracting cells and to remove waste products.

The right and left coronary arteries, branches of the ascending aorta, supply blood to the walls of the myocardium. After blood passes through the capillaries in the myocardium, it enters a system of cardiac (coronary) veins. Most of the cardiac veins drain into the coronary sinus, which opens into the right atrium.

The conduction system includes several components. The first part of the conduction system is the sinoatrial node. Without any neural stimulation, the sinoatrial node rhythmically initiates impulses 70 to 80 times per minute. Because it establishes the basic rhythm of the heartbeat, it is called the pacemaker of the heart. Other parts of the conduction system include the atrioventricular node, atrioventricular bundle, bundle branches, and conduction myofibers. All of these components coordinate the contraction and relaxation of the heart chambers.

Cardiac Cycle

The cardiac cycle refers to the alternating contraction and relaxation of the myocardium in the walls of the heart chambers, coordinated by the conduction system, during one heartbeat. Systole is the contraction phase of the cardiac cycle, and diastole is the relaxation phase. At a normal heart rate, one cardiac cycle lasts for 0.8 second.

Heart Sounds

The sounds associated with the heartbeat are due to vibrations in the tissues and blood caused by closure of the valves. Abnormal heart sounds are called murmurs.

Heart Rate

The sinoatrial node, acting alone, produces a constant rhythmic heart rate. Regulating factors are reliant on the atrioventricular node to increase or decrease the heart rate to adjust cardiac output to meet the changing needs of the body. Most changes in the heart rate are mediated through the cardiac center in the medulla oblongata of the brain. The center has both sympathetic and parasympathetic components that adjust the heart rate to meet the changing needs of the body.

Peripheral factors such as emotions, ion concentrations, and body temperature may affect heart rate. These are usually mediated through the cardiac center.

15. Define a blood pressure and explain factor affecting it.

Ans: Blood pressure (BP) is the pressure of circulating blood on the walls of blood vessels. Most of this pressure is due to work done by the heart by pumping blood through the circulatory system. Used without further specification, "blood pressure" usually refers to the pressure in large arteries of the systemic circulation. Blood pressure is usually expressed in terms of the systolic pressure (maximum during one heartbeat) over diastolic pressure (minimum in between two heartbeats) and is measured in millimeters of mercury (mm Hg), above the surrounding atmospheric pressure.

Blood pressure is influenced by cardiac output, systemic vascular resistance and arterial stiffness and varies depending on situation, emotional state, activity, and relative

health/disease states. In the short term, blood pressure is regulated by baroreceptors which act via the brain to influence the nervous and the endocrine systems.

Blood pressure that is too low is called hypotension, pressure that is consistently high is called hypertension and normal levels of blood pressure is called normotension. Both hypertension and hypotension have many causes and may be of sudden onset or of long duration. Long-term hypertension is a risk factor for many diseases, including heart disease, stroke and kidney failure. Long-term hypertension is more common than long-term hypotension, which is usually only diagnosed when it causes symptoms.

Factors Affecting Blood Pressure:

The professor passes out the exam. You turn to page one and read the questions. At that moment your heart is in your mouth and your blood is pounding in your ears because you realize that you have studied the wrong material! In lab, the teaching assistant euthanizes a frog for a muscle contraction experiment and the student next to you faints. Both of these situations reflect a dramatic change in blood pressure.

Fainting is the result of a sudden, huge drop in blood pressure. The blood pounding in your ears is

caused by a dramatic rise in blood pressure. But what is blood pressure? And why does it go up and down? In this tough topic section, we will discuss the components of blood pressure and the factors that regulate it.

We'll start by discussing how blood flow and resistance correlate to blood pressure in the vessels. To do that, we'll have to define some terms and talk about how they're related. After we cover those basics, we'll talk about how your body maintains blood pressure. Let's begin with a look at the overall system.

Your body is like a factory with steam pipes running outward from one big furnace. But instead of steam pipes, you have blood vessels and instead of a furnace you have a heart. Just like the steam pipes, if the pressure is too high, they burst and if it isn't high enough, the steam doesn't move and the furnace gets backed up. Part of the body's homeostatic control involves making fine or dramatic adjustments as needed to keep blood pressure within safe limits.

Before we go on to talk about how blood pressure is regulated, let's look more closely at the factors that are involved in establishing the blood pressure in the first place.

We define blood pressure, or BP, as the force per unit area exerted on a blood vessel wall by the blood contained within the wall. The more force the blood puts on the blood vessel, the higher the blood pressure. This pressure is expressed as millimeters of mercury. So a BP of one hundred twenty millimeters of mercury is the amount of pressure exerted to raise a column of mercury one hundred twenty millimeters high and keep it there.

Blood pressure refers to the arterial pressure in the largest arteries closest to the heart. The pressure initially established in the aorta after ventricle contraction begins a pressure gradient. This pressure gradient is highest near the heart and lowest in the tissues. The blood flows down the gradient because there is less resistance. By the time the blood reaches the veins, the pressure is very low.

What do we mean when we say that resistance decreases as the blood flows down the pressure?

gradient? Well, resistance is a measure of the amount of friction blood encounters as it travels through the vessels. Resistance is also used to describe any opposition to blood flow. Since most of the resistance is located in the peripheral circulation, we often call this peripheral resistance. There are three important sources of resistance: vessel length, blood viscosity, and vessel diameter. Let's discuss blood vessel length first.

Resistance, as it pertains to total blood vessel length is easy: The longer the blood vessel, the greater the resistance. As people gain weight, they need to build miles of small blood vessels to vascularize all of the extra tissue. This means that peripheral resistance increases dramatically, which can increase blood pressure. That's one of the reasons why obesity is correlated with high blood pressure.

Blood is thicker than water, according to the saying. And it is a correct observation. Blood viscosity in defined as the internal resistance to flow related to the thickness or stickiness of the fluid. The thicker the fluid, the more difficult it is for the molecules to keep flowing along. Maple syrup flows more slowly than water, because the syrup is more viscous. Generally speaking, blood thickness is pretty constant.

However, if there is an abnormal increase in red blood cells as in the case of polycythemia, or

significantly fewer blood cells like in the case of some anemias, the blood viscosity will vary and directly affect the peripheral resistance.

The last factor affecting resistance is blood vessel diameter. This factor is the most variable of the three and has the greatest impact on resistance. It changes often to adjust to internal cues. For example, if you get hot, the hypothalamus sends a message that you need to radiate away heat. So the peripheral blood vessels dilate to increase blood flow to the limbs. The increase in blood flow to the limbs, coupled with the cooling effect of sweating, will help cool the blood and consequently reduce your core body temperature.

In contrast to this, if it is cold outside, your hypothalamus sends a signal for blood vessels to constrict. This reduces blood flow to the periphery, which has the consequence of limiting the amount of cold blood entering the body core from the limbs. As your blood vessel diameter changes, so does the resistance, and so does the blood pressure.

The other reason that diameter impacts resistance so strongly is that the radius of the blood vessel

varies inversely to the fourth power with resistance. That may sound like complicated mathematics, but really it just means that if the radius of the vessel doubles, the resistance will decrease to one-sixteenth of its original value—a dramatic drop. So while larger vessels reduce resistance, small vessels increase the resistance. And there are many more smaller vessels than there are larger ones.

Okay. Let's summarize what we have discussed about factors that are involved in establishing your blood pressure. The three factors that contribute to blood pressure are resistance, blood viscosity, and blood vessel diameter. Resistance in peripheral circulation is used as a measure of this factor. The longer the vessel, the greater the resistance. Blood viscosity tells you how thick your blood is. Thicker blood is harder to push and pressure goes up. Blood vessel diameter is the most important factor in determining your blood pressure. Peripheral blood vessels are used to measure this since they are more numerous

than centralized blood vessels. The smaller the vessel, the more pressure is needed to push the same volume of blood through. As a result, blood pressure increases.

Now that you have a better understanding about the relationships between diameter, length, and

viscosity, let's discuss the relationships between these factors in different flow systems. Let's start with arterial blood pressure.

Arterial blood pressure is a consequence of two factors: the amount of blood forced into a vessel and how wide the arteries near the heart can expand. In the arteries, this translates to systolic pressure, the pressure exerted when the left ventricle forces blood into the aorta. One hundred twenty millimeters of mercury or one twenty over X is considered a normal measurement of arterial pressure.

When the contraction phase is complete and the ventricles relax, the elastic recoil of the aorta and

other major arteries near the heart keeps the blood flowing, although at much lower pressures.

Typically, diastolic pressure—the pressure as measured when the ventricles are relaxed--is measured at eighty millimeters of mercury. The difference between systolic and diastolic pressures is called the pulse pressure. So, when a nurse takes your pulse, she is actually measuring your heart rate using pulse pressure to determine ventricular contractions.

When your heart beats faster, it also beats more forcefully. This results in more blood being pushed out into the aorta and pulmonary trunk. Therefore, your arterial blood pressure changes in relation to your heartbeat, as a function of your activity. Mean arterial pressure or M.A.P. is an important pressure determinant. M.A.P. is the pressure that pushes your blood to the tissues. The farther away from the heart you get, the lower the M.A.P. This is due to increasing resistance and the loss of elastic recoil in the smaller arterial blood vessels. Take an athlete for example. Their M.A.P. will be greater than in someone who doesn't work out because the heart, muscles, and arterial blood vessels will be able to carry the blood farther. If there is a problem with arterial circulation, the M.A.P. will drop significantly. In addition, the limbs may appear pale and feel cold to the touch. By monitoring M.A.P., a clinician can tell the physical condition of a person as well as whether there may be a problem with peripheral circulation.

By the time the blood reaches the peripheral tissues, the blood pressure has decreased to thirty-five millimeters of mercury, and once it exits the capillary beds the blood pressure is down to fifteen millimeters of mercury. This low pressure is a good thing, because if the pressure was too high and blood flow too fast, the nutrients carried in circulation could not diffuse out into the tissues and cells would die. In addition, the capillaries are only one cell layer thick. So pressures that are higher could easily rupture these vessels.

The last type of pressure we will discuss is venous blood pressure. Arterial blood pressure pulsates with each ventricular contraction. Venous blood pressure is steady. That is why you cannot take your pulse on a vein. The pressure gradient in the veins is only about fifteen millimeters of mercury (the same as in the capillaries).

By the time the blood reaches the venous system, there is not enough pressure to return the blood to the heart. Veins have several modifications that help them get the blood to

flow back to the heart. First, veins have valves, which prevent blood from flowing backwards. Secondly, more skeletal muscle activity increases the efficiency of venous return. As the skeletal muscles surrounding the deep veins contract and relax, they move blood toward the heart. This is called the muscular pump. In addition to this, the pressure changes in the thoracic cavity during breathing help facilitate venous return. This is called the respiratory pump. Of the two, the skeletal muscle pump is the more important.

In this final part of this tough topics section, we'll discuss the mechanisms for maintaining the blood pressure. The most important mechanisms to regulate are peripheral resistance and blood volume. This occurs through the cooperation of the heart, blood vessels, and kidneys. In this section we will discuss examples of short-term mechanisms as well as long term mechanisms for blood pressure maintenance.

Let's begin with short term mechanisms.

Short term mechanisms for regulating blood pressure involve hormonal control and neural mechanisms.

Many hormones are involved in BP regulation, including norepineprhine and epinephrine, antidiuretic hormone, angiotensin two, erythropoietin, and natriuretic peptides. Norephinephrine and epinephrine predominate during periods of stress. These hormones enhance the sympathetic fight-or-flight re sponse in stressful situations like finding out that you didn't prepare properly for your biology test. Antiduretic

hormone, or ADH, stimulates water conservation at the kidneys. In cases where blood pressure falls dangerously low, like when you cut yourself very badly, ADH is released to increase pressure by causing dramatic vasoconstriction in your peripheral arterioles.

Erythropoietin is a hormone secreted by the kidneys that causes an increase in red blood cell production. This increases blood viscosity, which causes BP to increase. Atrial natriuretic peptide causes blood volume and blood pressure to decrease by blocking renin and aldosterone, causing the kidneys to excrete more sodium and water. This lowers the blood volume and consequently causes the blood pressure to drop. Short-term neural control mechanisms all function by altering peripheral blood resistance and consequently, cardiac output. They ensure that MAP is adequate by altering blood vessel diameter. In addition, they can redirect flow based on organ demand. So, while you work out, blood flow to the digestive system decreases and increases to the skeletal muscles. These changes are regulated by the vasomotor center located in the medulla of the brain.

These few examples of hormone-related mechanisms for short term regulation of BP all target

peripheral resistance, primarily through vasoconstriction and vasodilation. Now let's discuss some

mechanisms of long-term regulation of blood pressure.

Long term control of blood pressure is mediated by the kidneys and targets blood volume as the

regulatory mechanism. To maintain a constant blood volume, the kidneys keep the average blood

volume at about five liters, although this volume can vary slightly, depending upon age, size, and

gender.

Kidneys can act directly and indirectly to stabilize the mean arterial pressure. First let's look at direct mechanisms. Direct action by the kidneys involves increasing the filtration rate through the kidneys. If the blood volume and consequently the blood pressure rise, the filtrate is rushed through the kidney tubules quickly. The result is an increase in the volume of filtrate lost in the urine. This decrease in blood volume causes a parallel decrease in the blood pressure and the kidneys resume their normal filtration rate.

The indirect mechanism for renal control of blood pressure is through the interactions of the hormone's renin and angiotensin. If arterial blood pressure decreases, the kidneys release renin. Renin causes the formation of angiotensin. Angiotensin is a strong vasoconstrictor. Angio means blood vessels and tension means tension. So, this hormone regulation targets necessary increases in blood pressure by increasing the peripheral resistance.

Angiotensin also causes the secretion of the hormones aldosterone to retain sodium and ADH to retain water at the kidneys, which in turn causes more water to be reclaimed. This effectively increases the blood volume and pressure.

Let's summarize what we have discussed. You should now know that blood pressure is measured in the arterial blood vessels closet to the heart and is a direct function of ventricular contractions. BP can be measured as a function of the resistance through the blood vessels and blood flow. The most important factor affecting BP is the diameter of the blood vessel, but vessel length and the viscosity of the blood are also factors. In addition, the greater the blood volume in the vessels, the greater the blood pressure.

Blood pressure can be controlled in the short term through hormones and in the long term through

kidney function.

16. Explain the location anatomy histology of and function of small intestine.

Ans: The small intestine is the longest part of the digestive system. It extends from the stomach (pylorus) to the large intestine (cecum) and consists of three parts: duodenum, jejunum and ileum. The main functions of the small intestine are to complete digestion of food and to absorb nutrients.

Dysfunction of the small intestine can bring you some uneasy experiences such as diarrhea while travelling or worse, on a date. This article will discuss the anatomy, function and neuro vasculature supply of the small intestines.

Anatomy

The small intestine is divided into the duodenum, jejunum, and ileum. Together these can extend up to six meters in length. All three parts are covered with the greater omentum anteriorly. The duodenum has both intraperitoneal and retroperitoneal parts, while the jejunum and ileum are entirely intraperitoneal organs. As the small intestine is the main site for the final stages of food digestion and its absorption, its gross and microanatomy are adjusted to that function.

Duodenum

The duodenum by definition is the first part of the small intestine. It extends from the pyloric sphincter of the stomach, wraps around the head of the pancreas in a C-shape and ends at duodenojejunal flexure. This flexure is attached to the posterior abdominal wall

by a peritoneal fold called the suspensory muscle (ligament) of duodenum, also called the ligament of Treitz.

The duodenum has four parts: superior (duodenal bulb/ampulla), descending, horizontal and ascending. Among several features of the duodenum, we'll list the two most important:

The superior part (duodenal bulb/ampulla) is the only intraperitoneal part, as the hepatoduodenal ligament and greater omentum attach to it.

The descending part of the duodenum has an opening called the major duodenal papilla (tubercle of Vater). The papilla contains the hepatopancreatic sphincter (sphincter of Oddi, Glissons' sphincter) which regulates the emptying of the bile from the hepatopancreatic ampulla.

Jejunum

The jejunum is the second part of the small intestine. It begins at the duodenojejunal flexure and is found in the upper left quadrant of the abdomen. The jejunum is entirely intraperitoneal as the mesentery proper attaches it to the posterior abdominal wall.

There is no clear line of demarcation between the jejunum and ileum, but there are some anatomical and histological differences that distinguish them:

- The jejunum represents the proximal two-fifths of the jejunum-ileum continuum
- The wall of the jejunum is thicker and its lumen is wider than in ileum
- The jejunum contains more prominent circular folds of Kerckring

Ileum

The ileum is the last and longest part of the small intestine. It is found in the lower right quadrant of the abdomen, although the terminal ileum can extend into the pelvic cavity. The ileum terminates at the ileal orifice (ileocecal junction) where the cecum of the large intestine begins.

At the ileocecal junction, the lamina muscularis of the ileum protrudes into the lumen of the cecum forming a structure called the ileocecal fold. These muscular fibers form a muscular ring within the fold called the ileocecal sphincter which controls the emptying of ileal content into the large intestine.

Histology

Histologically, the small intestine has four layers. From internal to external, they are mucosa, submucosa, muscularis externa, and serosa. These layers are easy to remember using the mnemonic M.S.M.S. There are several unique features in the small intestine, which act to significantly increase its absorptive surface:

- Circular folds (Plicae circulares); Image: Begoña Rodriguez
- Circular folds (Plicae circulares)
- Circular folds (valves of Kerckring, plicae circulares) are the transverse folds of mucosa found predominantly in the distal duodenum and proximal jejunum

Intestinal villi are fingerlike extensions of intestinal mucosa which project into the lumen of the small intestine. Between the villi are intestinal glands (crypts of Lieberkuhn) which secrete intestinal juice rich in digestive enzymes.

Microvilli are projections found on the apical surface of each intestinal cell (enterocyte)

There are also features of the small intestine which are segment-specific:

Peyer's patches are part of gastrointestinal associated lymphoid tissue (GALT). They are found in ileum.
Brunner glands are found in the submucosa of the duodenum. They produce mucus rich in alkalines which protects the duodenum from the corrosive effects of gastric acid.

17. Write note on liver.

Ans: The liver is an organ only found in vertebrates which detoxifies various metabolites, synthesizes proteins and produces biochemicals necessary for digestion and growth. In humans, it is located in the right upper quadrant of the abdomen, below the diaphragm. Its other roles in metabolism include the regulation of glycogen storage, decomposition of red blood cells, and the production of hormones.
The liver is an accessory digestive organ that produces bile, an alkaline fluid containing cholesterol and bile acids, which helps the breakdown of fat. The gallbladder, a small pouch that sits just under the liver, stores bile produced by the liver which is afterwards moved to the small intestine to complete digestion. The liver's highly specialized tissue, consisting of mostly hepatocytes, regulates a wide variety of high-volume biochemical reactions, including the synthesis and breakdown of small and complex molecules, many of which are necessary for normal vital functions. Estimates regarding the organ's total number of functions vary, but textbooks generally cite it being around 500.
It is not yet known how to compensate for the absence of liver function in the long term, although liver dialysis techniques can be used in the short term. Artificial livers are yet to be developed to promote long-term replacement in the absence of the liver. As of 2018, liver transplantation is the only option for complete liver failure.
Structure
The liver is a reddish-brown, wedge-shaped organ with two lobes of unequal size and shape. A human liver normally weighs approximately 1.5 kg (3.3 lb)[9] and has a width of about 15 cm (6 in). There is considerable size variation between individuals, with the standard reference range for men being 970–1,860 g (2.14–4.10 lb) and for women 600–1,770 g (1.32–3.90 lb). It is both the heaviest internal organ and the largest gland in the human body. Located in the right upper quadrant of the abdominal cavity, it rests just below the diaphragm, to the right of the stomach and overlies the gallbladder.
The liver is connected to two large blood vessels: the hepatic artery and the portal vein. The hepatic artery carries oxygen-rich blood from the aorta via the celiac plexus, whereas the portal vein carries blood rich in digested nutrients from the entire gastrointestinal tract and also from the spleen and pancreas. These blood vessels subdivide into small capillaries known as liver sinusoids, which then lead to lobules.
Lobules are the functional units of the liver. Each lobule is made up of millions of hepatic cells (hepatocytes), which are the basic metabolic cells. The lobules are held together by a fine, dense, irregular, fibroelastic connective tissue layer extending from the fibrous capsule covering the entire liver known as Glisson's capsule. This extends into the structure of the liver by accompanying the blood vessels, ducts, and nerves at the hepatic hilum. The whole surface of the liver, except for the bare area, is covered in a serous coat derived from the peritoneum, and this firmly adheres to the inner Glisson's capsule.
Gross anatomy

Terminology related to the liver often starts in hepat- from ἡπατο-, from the Greek word for liver.

Lobes

Further information: Lobes of liver

The liver, viewed from above, showing the left and right lobes separated by the falciform ligament

The liver, viewed from below, surface showing four lobes and the impressions

The liver is grossly divided into two parts when viewed from above – a right and a left lobe - and four parts when viewed from below (left, right, caudate, and quadrate lobes).

The falciform ligament divides the liver into a left and right lobe. From below, the two additional lobes are located between the right and left lobes, one in front of the other. A line can be imagined running from the left of the vena cava and all the way forward to divide the liver and gallbladder into two halves. This line is called Cantlie's line.

Other anatomical landmarks include the ligamentum venosum and the round ligament of the liver (ligamentum teres), which further divide the left side of the liver in two sections. An important anatomical landmark, the porta hepatis, divides this left portion into four segments, which can be numbered starting at the caudate lobe as I in an anticlockwise manner. From this parietal view, seven segments can be seen, because the eighth segment is only visible in the visceral view.

Surfaces

On the diaphragmatic surface, apart from a triangular bare area where it connects to the diaphragm, the liver is covered by a thin, double-layered membrane, the peritoneum, that helps to reduce friction against other organs. This surface covers the convex shape of the two lobes where it accommodates the shape of the diaphragm. The peritoneum folds back on itself to form the falciform ligament and the right and left triangular ligaments.

These peritoneal ligaments are not related to the anatomic ligaments in joints, and the right and left triangular ligaments have no known functional importance, though they serve as surface landmarks. The falciform ligament functions to attach the liver to the posterior portion of the anterior body wall.

The visceral surface or inferior surface is uneven and concave. It is covered in peritoneum apart from where it attaches the gallbladder and the porta hepatis.[18] The fossa of gall bladder lies to the right of the quadrate lobe, occupied by the gallbladder with its cystic duct close to the right end of porta hepatis.

Impressions

Impressions of the liver

Several impressions on the surface of the liver accommodate the various adjacent structures and organs. Underneath the right lobe and to the right of the gallbladder fossa are two impressions, one behind the other and separated by a ridge. The one in front is a shallow colic impression, formed by the hepatic flexure and the one behind is a deeper renal impression accommodating part of the right kidney and part of the suprarenal gland.

The suprarenal impression is a small, triangular, depressed area on the liver. It is located close to the right of the fossa, between the bare area and the caudate lobe, and immediately above the renal impression. The greater part of the suprarenal impression is devoid of peritoneum and it lodges the right suprarenal gland.

Medial to the renal impression is a third and slightly marked impression, lying between it and the neck of the gall bladder. This is caused by the descending portion of the duodenum, and is known as the duodenal impression.

The inferior surface of the left lobe of the liver presents behind and to the left of the gastric impression. This is moulded over the upper front surface of the stomach, and to the right of this is a rounded eminence, the tuber omentale, which fits into the concavity of the lesser curvature of the stomach and lies in front of the anterior layer of the lesser omentum.

Microscopic anatomy

Cells, ducts, and blood vessels

Microscopic anatomy of the liver

Types of capillaries–sinusoid on right

Microscopically, each liver lobe is seen to be made up of hepatic lobules. The lobules are roughly hexagonal and consist of plates of hepatocytes radiating from a central vein. The central vein joins to the hepatic vein to carry blood out from the liver. A distinctive component of a lobule is the portal triad, which can be found running along each of the lobule's corners. The portal triad, misleadingly named, consists of five structures: a branch of the hepatic artery, a branch of the hepatic portal vein, and a bile duct, as well as lymphatic vessels and a branch of the vagus nerve. Between the hepatocyte plates are liver sinusoids, which are enlarged capillaries through which blood from the hepatic portal vein and hepatic artery enters via the portal triads, then drains to the central vein.

Histology, the study of microscopic anatomy, shows two major types of liver cell: parenchymal cells and nonparenchymal cells. About 70–85% of the liver volume is occupied by parenchymal hepatocytes. Nonparenchymal cells constitute 40% of the total number of liver cells but only 6.5% of its volume. The liver sinusoids are lined with two types of cell, sinusoidal endothelial cells, and phagocytic Kupffer cells. Hepatic stellate cells are nonparenchymal cells found in the perisinusoidal space, between a sinusoid and a hepatocyte. Additionally, intrahepatic lymphocytes are often present in the sinusoidal lumen.

Functional anatomy

Hilum of the liver, circled in yellow

The central area or hepatic hilum, includes the opening known as the porta hepatis which carries the common bile duct and common hepatic artery, and the opening for the portal vein. The duct, vein, and artery divide into left and right branches, and the areas of the liver supplied by these branches constitute the functional left and right lobes. The functional lobes are separated by the imaginary plane, Cantlie's line, joining the gallbladder fossa to the inferior vena cava. The plane separates the liver into the true right and left lobes. The middle hepatic vein also demarcates the true right and left lobes. The right lobe is further divided into an anterior and posterior segment by the right hepatic vein. The left lobe is divided into the medial and lateral segments by the left hepatic vein.

The hilum of the liver is described in terms of three plates that contain the bile ducts and blood vessels. The contents of the whole plate system are surrounded by a sheath. The three plates are the hilar plate, the cystic plate and the umbilical plate and the plate system is the site of the many anatomical variations to be found in the liver.

18. Explain composition and function of saliva.

Ans: Saliva (commonly referred to as spit) is an extracellular fluid produced and secreted by salivary glands in the mouth. In humans, saliva is 99.5% water plus electrolytes, mucus, white blood cells, epithelial cells (from which DNA can be extracted), enzymes (such as amylase and lipase), antimicrobial agents such as secretory IgA, and lysozymes.

The enzymes found in saliva are essential in beginning the process of digestion of dietary starches and fats. These enzymes also play a role in breaking down food particles entrapped within dental crevices, thus protecting teeth from bacterial decay. Saliva also performs a lubricating function, wetting food and permitting the initiation of swallowing, and protecting the oral mucosa from drying out.

Various animal species have special uses for saliva that go beyond predigestion. Some swifts use their gummy saliva to build nests. Aerodramus nests form the basis of bird's nest soup. Cobras, vipers, and certain other members of the venom clade hunt with venomous saliva injected by fangs. Some caterpillars produce silk fiber from silk proteins stored in modified salivary glands.

Composition

Produced in salivary glands, human saliva comprises 99.5% water, but also contains many important substances, including electrolytes, mucus, antibacterial compounds and various enzymes.

Water: 99.49%

Electrolytes:

2–21 mmol/L sodium (lower than blood plasma)

10–36 mmol/L potassium (higher than plasma)

1.2–2.8 mmol/L calcium (similar to plasma)

0.08–0.5 mmol/L magnesium

5–40 mmol/L chloride (lower than plasma)

25 mmol/L bicarbonate (higher than plasma)

1.4–39 mmol/L phosphate

Iodine (mmol/L concentration is usually higher than plasma, but dependent variable according to dietary iodine intake)

Mucus (mucus in saliva mainly consists of mucopolysaccharides and glycoproteins)

Antibacterial compounds (thiocyanate, hydrogen peroxide, and secretory immunoglobulin A)

Epidermal growth factor (EGF)

Various enzymes; most notably:

α-amylase (EC3.2.1.1), or ptyalin, secreted by the acinar cells of the parotid and submandibular glands, starts the digestion of starch before the food is even swallowed; it has a pH optimum of 7.4

Lingual lipase, which is secreted by the acinar cells of the sublingual gland; has a pH optimum around 4.0 so it is not activated until entering the acidic environment of the stomach

Kallikrein, an enzyme that proteolytically cleaves high-molecular-weight kininogen to produce bradykinin, which is a vasodilator; it is secreted by the acinar cells of all three major salivary glands

Antimicrobial enzymes that kill bacteria:

Lysozyme

Salivary lactoperoxidase

Lactoferrin

Immunoglobulin A

Proline-rich proteins (function in enamel formation, Ca2+-binding, microbe killing and lubrication)

Minor enzymes including: salivary acid phosphatases A+B, N-acetylmuramoyl-L-alanine amidase, NAD(P)H dehydrogenase (quinone), superoxide dismutase, glutathione transferase, class 3 aldehyde dehydrogenase, glucose-6-phosphate isomerase, and tissue kallikrein (function unknown)

Cells: possibly as many as 8 million human and 500 million bacterial cells per mL. The presence of bacterial products (small organic acids, amines, and thiols) causes saliva to sometimes exhibit a foul odor.

Opiorphin, a pain-killing substance found in human saliva

Haptocorrin, a protein which binds to Vitamin B12 to protect it against degradation in the stomach, before it binds to intrinsic factor

Daily salivary output

There is much debate about the amount of saliva that is produced in a healthy person. Production is estimated at 1500ml per day and is generally accepted that during sleep the amount drops significantly. In humans, the submandibular gland contributes around 70–75% of secretion, while the parotid gland secretes about 20–25% and small amounts are secreted from the other salivary glands.

Functions

Saliva contributes to the digestion of food and to the maintenance of oral hygiene. Without normal salivary function the frequency of dental caries, gum disease (gingivitis and periodontitis), and other oral problems increases significantly.

Lubricant

Saliva coats the oral mucosa mechanically protecting it from trauma during eating, swallowing, and speaking. Mouth soreness is very common in people with reduced saliva (xerostomia) and food (especially dry food) sticks to the inside of the mouth.

Digestion

The digestive functions of saliva include moistening food and helping to create a food bolus. The lubricative function of saliva allows the food bolus to be passed easily from the mouth into the esophagus. Saliva contains the enzyme amylase, also called ptyalin, which is capable of breaking down starch into simpler sugars such as maltose and dextrin that can be further broken down in the small intestine. About 30% of starch digestion takes place in the mouth cavity. Salivary glands also secrete salivary lipase (a more potent form of lipase) to begin fat digestion. Salivary lipase plays a large role in fat digestion in newborn infants as their pancreatic lipase still needs some time to develop.

Role in taste

Saliva is very important in the sense of taste. It is the liquid medium in which chemicals are carried to taste receptor cells (mostly associated with lingual papillae). Persons with little saliva often complain of dysgeusia (i.e. disordered taste, e.g. reduced ability to taste, or having a bad, metallic taste at all times). A rare condition identified to affect taste is that of 'Saliva Hypernatrium', or excessive amounts of sodium in saliva that is not caused by any other condition (e.g., Sjögren syndrome), causing everything to taste 'salty'.

Other

Saliva maintains the pH of the mouth. Saliva is supersaturated with various ions. Certain salivary proteins prevent precipitation, which would form salts. These ions act as a buffer, keeping the acidity of the mouth within a certain range, typically pH 6.2–7.4. This prevents minerals in the dental hard tissues from dissolving.

Saliva secretes carbonic anhydrase (gustin), which is thought to play a role in the development of taste buds.

Saliva contains EGF. EGF results in cellular proliferation, differentiation, and survival. EGF is a low-molecular-weight polypeptide first purified from the mouse submandibular gland, but since then found in many human tissues including submandibular gland, parotid gland. Salivary EGF, which seems also regulated by dietary inorganic iodine, also plays an important physiological role in the maintenance of oro-esophageal and gastric tissue integrity. The biological effects of salivary EGF include healing of oral and gastroesophageal ulcers, inhibition of gastric acid secretion, stimulation of DNA synthesis as well as mucosal protection from intraluminal injurious factors such as gastric acid, bile acids, pepsin, and trypsin and to physical, chemical and bacterial agents.

Production

The production of saliva is stimulated both by the sympathetic nervous system and the parasympathetic.

The saliva stimulated by sympathetic innervation is thicker, and saliva stimulated parasympathetically is more fluid-like.

Sympathetic stimulation of saliva is to facilitate respiration, whereas parasympathetic stimulation is to facilitate digestion.

Parasympathetic stimulation leads to acetylcholine (ACh) release onto the salivary acinar cells. ACh binds to muscarinic receptors, specifically M3, and causes an increased intracellular calcium ion concentration (through the IP3/DAG second messenger system). Increased calcium causes vesicles within the cells to fuse with the apical cell membrane leading to secretion. ACh also causes the salivary gland to release kallikrein, an enzyme that converts kininogen to lysyl-bradykinin. Lysyl-bradykinin acts upon blood vessels and capillaries of the salivary gland to generate vasodilation and increased capillary permeability, respectively. The resulting increased blood flow to the acini allows the production of more saliva. In addition, Substance P can bind to Tachykinin NK-1 receptors leading to increased intracellular calcium concentrations and subsequently increased saliva secretion. Lastly, both parasympathetic and sympathetic nervous stimulation can lead to myoepithelium contraction which causes the expulsion of secretions from the secretory acinus into the ducts and eventually to the oral cavity.

Sympathetic stimulation results in the release of norepinephrine. Norepinephrine binding to α-adrenergic receptors will cause an increase in intracellular calcium levels leading to

more fluid vs. protein secretion. If norepinephrine binds β-adrenergic receptors, it will result in more protein or enzyme secretion vs. fluid secretion. Stimulation by norepinephrine initially decreases blood flow to the salivary glands due to constriction of blood vessels but this effect is overtaken by vasodilation caused by various local vasodilators.

Saliva production may also be pharmacologically stimulated by the so-called sialagogues. It can also be suppressed by the so-called antisialagogues.

19. Write the characteristics of living organisms.

Ans: The Characteristics of Life: List the defining characteristics of biological life

Biology is the science that studies life, but what exactly is life? This may sound like a silly question with an obvious response, but it is not always easy to define life. For example, a branch of biology called virology studies viruses, which exhibit some of the characteristics of living entities but lack others. It turns out that although viruses can attack living organisms, cause diseases, and even reproduce, they do not meet the criteria that biologists use to define life. Consequently, virologists are not biologists, strictly speaking. Similarly, some biologists study the early molecular evolution that gave rise to life; since the events that preceded life are not biological events, these scientists are also excluded from biology in the strict sense of the term.

Properties of Life

All living organisms share several key characteristics or functions: order, sensitivity or response to the environment, reproduction, growth and development, regulation, homeostasis, and energy processing. When viewed together, these characteristics serve to define life.

Order

A photo shows a light-colored toad covered in bright green spots.

Organisms are highly organized, coordinated structures that consist of one or more cells. Even very simple, single-celled organisms are remarkably complex: inside each cell, atoms make up molecules; these in turn make up cell organelles and other cellular inclusions.

In multicellular organisms (Figure 1), similar cells form tissues. Tissues, in turn, collaborate to create organs (body structures with a distinct function). Organs work together to form organ systems.

Sensitivity or Response to Stimuli

Organisms respond to diverse stimuli. For example, plants can bend toward a source of light, climb on fences and walls, or respond to touch

A photograph of the Mimosa pudica shows a plant with many tiny leaves connected to a central stem. Four of these stems connect together.

Even tiny bacteria can move toward or away from chemicals (a process called chemotaxis) or light (phototaxis). Movement toward a stimulus is considered a positive response, while movement away from a stimulus is considered a negative response.

Watch this video to see how plants respond to a stimulus—from opening to light, to wrapping a tendril around a branch, to capturing prey.

Reproduction

Single-celled organisms reproduce by first duplicating their DNA, and then dividing it equally as the cell prepares to divide to form two new cells. Multicellular organisms often produce specialized reproductive germline cells that will form new individuals. When reproduction occurs, genes containing DNA are passed along to an organism's offspring. These genes ensure that the offspring will belong to the same species and will have similar characteristics, such as size and shape.

Growth and Development

a mother dog nursing approximately five puppies. three are black, one is brown, and the other is pale yellow. The mother is a light brown.

Organisms grow and develop following specific instructions coded for by their genes. These genes provide instructions that will direct cellular growth and development, ensuring that a species' young will grow up to exhibit many of the same characteristics as its parents.

Regulation

Even the smallest organisms are complex and require multiple regulatory mechanisms to coordinate internal functions, respond to stimuli, and cope with environmental stresses. Two examples of internal functions regulated in an organism are nutrient transport and blood flow. Organs (groups of tissues working together) perform specific functions, such as carrying oxygen throughout the body, removing wastes, delivering nutrients to every cell, and cooling the body.

Homeostasis

In order to function properly, cells need to have appropriate conditions such as proper temperature, pH, and appropriate concentration of diverse chemicals. These conditions may, however, change from one moment to the next. Organisms are able to maintain internal conditions within a narrow range almost constantly, despite environmental changes, through homeostasis (literally, "steady state")—the ability of an organism to maintain constant internal conditions. For example, an organism needs to regulate body temperature through a process known as thermoregulation. Organisms that live in cold climates, such as the polar bear (Figure 4), have body structures that help them withstand low temperatures and conserve body heat. Structures that aid in this type of insulation include fur, feathers, blubber, and fat. In hot climates, organisms have methods (such as perspiration in humans or panting in dogs) that help them to shed excess body heat.

Energy Processing

All organisms use a source of energy for their metabolic activities. Some organisms capture energy from the sun and convert it into chemical energy in food (photosynthesis); others use chemical energy in molecules they take in as food (cellular respiration).

20. Write short note on five kingdom classification

Ans: Five Kingdom Classification

Very early on, scientists began grouping the living organisms under different categories. Some biologists classified organisms into plants and animals. Ernst Haeckel, Robert Whittaker, and Carl Woese are some biologists who attempted a broader system of classification. Amongst these, the Five Kingdom Classification proposed by Robert Whittaker stood out and is widely used.

Whitaker proposed that organisms should be broadly divided into kingdoms, based on certain characters like the structure of the cell, mode of nutrition, the source of nutrition, interrelationship, body organization, and reproduction. According to this system, there are five main kingdoms. They are:

Kingdom Monera
Kingdom Protista
Kingdom Fungi
Kingdom Animalia
Kingdom Plantae

Kingdoms are divided into subgroups at various levels. The following flowchart shows the hierarchy of classification.

Kingdom → Phylum → Class → Order → Family → Genus → Species

Distinguishing Features of the Five Kingdoms

Kingdom Monera

These organisms are prokaryotic and unicellular. They do not have a well-defined nucleus and also lack cell organelles. Some organisms show the presence of cell wall while there are others without a cell wall. Consequently, some organisms are autotrophic and others are heterotrophic. Examples include Bacteria, Cyanobacteria, and Mycoplasma.

Kingdom Protista

Organisms grouped under Kingdom Protista are all unicellular, but eukaryotic organisms. These are the simplest forms of eukaryotes that exhibit either autotrophic or heterotrophic mode of nutrition. Some organisms have appendages such as cilia or flagella or pseudopodia to move around. Some examples are Diatoms, Protozoans like Amoeba, Paramoecium

Kingdom Fungi

Heterotrophic, Multicellular and Eukaryotic organisms are grouped under Kingdom Fungi. Their mode of nutrition is saprophytic as they use decaying organic matter as food. They have cell walls, which are made up of a substance called Chitin. Fungi also form a symbiotic association with some blue-green algae. Yeast, Mushroom, Aspergillus are examples of Fungi.

Kingdom Plantae

These are Eukaryotic, Multicellular organisms with a cell wall that is made up of cellulose. They are autotrophs and synthesize their own food through the process of photosynthesis. This kingdom includes all plants.

Based on the body differentiation and presence or absence of specialized vascular tissue, Kingdom Plantae is divided into different divisions, namely Thallophyta, Bryophyta, Pteridophyta, Gymnosperms, and Angiosperms. Examples are Spirogyra, Ferns, Pines, and Mango Plant etc.

Kingdom Animalia

This Kingdom includes organisms that are Multicellular, Eukaryotic, without the presence of cell wall. They have a heterotrophic mode of nutrition. They also exhibit great diversity. Some organisms are simple while others have a complex body with

specialized tissue differentiation and body organs. The Animal Kingdom is divided into many phyla and classes. Some of the phyla are Porifera, Coelenterata, Arthropoda, Echinodermata, Chordata etc. Examples – Hydra, Starfish, Earthworms, Monkeys, Birds etc.

21. Write note on Plant Growth Regulators.

Ans: Plant Growth Regulators

Plant Growth Regulators are defined as small, simple chemicals produced naturally by plants to regulate their growth and development.

Characteristics

Plant Growth Regulators can be of a diverse chemical composition such as gases (ethylene), terpenes (gibberellic acid) or carotenoid derivates (abscisic acid). They are also referred to as plant growth substances, phytohormones or plant hormones. Based on their action, they are broadly classified as follows:

Plant Growth Promoters – They promote cell division, cell enlargement, flowering, fruiting and seed formation. Examples are auxins, gibberellins and cytokinins.

Plant Growth Inhibitors – These chemicals inhibit growth and promote dormancy and abscission in plants. An example is an abscisic acid.

(Note: Ethylene can be a promoter or an inhibitor, but is largely a Plant Growth Inhibitor.)

Browse more about Plant Growth and Development

Plant Growth and Development

- Growth and its Phases
- Vernalisation
- Photoperiodism

All plant growth regulators were discovered accidentally. Let's take a detailed look at each regulator and learn about it more closely:

Auxins

Discovery: Auxins were the first growth hormone to be discovered. They were discovered due to the observations of Charles Darwin and his son, Francis Darwin. The Darwins observed that the coleoptile (protective sheath) in canary grass grows and bends towards the source of light. This phenomenon is 'phototropism'. In addition, their experiments showed that the coleoptile tip was the site responsible for the bending. Finally, this led to the isolation of the first auxin by F. W. Went from the coleoptile tip of oat seedlings.

Types

First isolated from human urine, auxin is a term applied to natural and synthetic compounds that have growth regulating properties. Plants produce natural auxins such as Indole-3-acetic acid (IAA) and Indole butyric acid (IBA). Natural auxins are found in growing stems and roots from where they migrate to their site of action. Naphthalene acetic acid (NAA) and 2, 4-dichlorophenoxyacetic (2, 4-D) are examples of synthetic auxins.

Effects

- Promote flowering in plants like pineapple.
- Help to initiate rooting in stem cuttings.

- Prevent dropping of fruits and leaves too early.
- Promote natural detachment (abscission) of older leaves and fruits.
- Control xylem differentiation and help in cell division.

Applications

- Used for plant propagation.
- To induce parthenocarpy i.e. the production of fruit without prior fertilization.
- 2, 4-D is widely used as a herbicide to kill dicotyledonous weeds.
- Used by gardeners to keep lawns weed-free.
- Note: The growing apical bud in higher plants inhibits the growth of the lateral buds. This phenomenon is 'Apical Dominance'. Removal of the apical bud allows the lateral buds to grow. This technique is commonly used in tea plantations and hedge-making.

Assignment-1

Question	Details	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Write the characteristics of living organisms.	1	1	1
2	Write a note on nervous tissue along with its structure function and location.	4	2	2
3	Write a note on Acquire immunity and natural immunity.	3	1	1
4	Explain composition and function of saliva.	1	2	2
5	Draw a neat labeled diagram of conducting system of heart and explain the conducting system of heart.	2	1	1

CLASS TEST-1

Question	Details	Marks	Unit no. as per syllabus	CO mapped	Bloom's Taxonomy Level
1	Enlist the basic types of tissue with its characteristic	3	1	1	1
2	Give the structure and function of RBC.	5	4	2	2
3	Write a note on lymph node.	5	3	1	1
4	Draw a neat labeled diagram of heart.	5	1	2	2
5	Draw a neat labeled diagram of digestive system.	2	2	1	1

Semester Exam Question Paper

Remedial biology

Q.1. Solve the any one. **10 M**

1. Explain circulatory & conduction system of heart.
2. Explain human excretory system & their structure & functions.

Q.2. Solve any five. **25 M**

1. Explain five kingdom classification of life.
2. Write a note on composition of blood.
3. Write note on photosynthesis & factors affecting it.
4. Explain human respiratory system.
5. Write note on nitrogen cycle.
6. Write note on cardiac cycle, cardiac output.
7. Write a note on menstrual cycle.

All the Best!

SUBJECT

BP106RMT REMEDIAL MATHEMATICS

(RM)

SCHEME

BP106RMT REMEDIAL MATHEMATICS

Course of study

Course Code	Course Name	Lectures Assigned			
		Theory	Practical	Tutorial	Total
BP106RMT	Remedial Mathematics	02	-	-	02

Schemes for internal assessments and end semester examinations

Course Code	Course Name	Internal Assessment				End Semester Exams		Total Marks
			Sessional Exams					
		Continuous Mode	Marks	Duration	Total	Marks	Duration	
BP106 RMT	RM	5	10	1 Hrs	15	35	1.5 Hrs	50

SYLLABUS

BP106RMT. REMEDIAL MATHEMATICS

(Theory)

30 Hours

Scope:

This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Course Delivery:

The course will be delivered through lectures, class room interaction, and presentations.

Course Objectives:

Upon completion of the course the student shall be able to

- Know the theory and their application in Pharmacy
- Solve the different types of problems by applying theory
- Appreciate the important application of mathematics in Pharmacy

COURSE CONTENT	
UNIT-I	**07 Hours**
Partial fraction Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction , Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function:** Real Valued function, Classification of real valued functions, **Limits and continuity :** Introduction, Limit of a function, Definition of limit of a function	
UNIT-II	**07 Hours**
Matrices and Determinant: Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equation	
UNIT-III	**07 Hours**
Calculus **Differentiation** : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of *xn w.r.t*x, where *n* is any rational number, Derivative of *ex*,, Derivative of loge *x* , Derivative of *ax*, Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application	
UNIT-IV	**05 Hours**
Analytical Geometry **Introduction:** Signs of the Coordinates, Distance formula, **Straight Line** : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line **Integration:** Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application	
UNIT-V	**04 Hours**

Differential Equations : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations** **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**
Recommended Books: 1. Differential Calculus by Shanthinarayan 2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H. 3. Integral Calculus by Shanthinarayan 4. Higher Engineering Mathematics by Dr.B. S. Grewal

LESSON PLAN

Sr. No	Topic	No. of hours
1	**UNIT I**	
	Partial fraction	
	Introduction, Polynomial, Rational fractions, Proper and Improper fractions	1
	Partial fraction , Resolving into Partial fraction Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics	1
	Logarithms Introduction, Definition, Theorems/Properties of logarithms,	1
	Common logarithms, Characteristic and Mantissa, worked examples,	1
	application of logarithm to solve pharmaceutical problems. Function: Real Valued function, Classification of real valued functions	1
	Limits and continuity : Introduction , Limit of a function, Definition of limit of a function (□ - □ definition)	1
2	**UNIT-II**	
	Matrices and Determinant: Introduction matrices, Types of matrices	1
	Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants	1
	Properties of determinants , Product of determinants, Minors and co-Factors Adjoint or adjugate of a square matrix ,	1
	Singular and non-singular matrices,	1
	Inverse of a matrix, Solution of system of linear of equations using matrix method	1
	Cramer's rule, Characteristic equation and roots of a square matrix,	1
	Cayley–Hamilton theorem, Applicationof Matrices in solving Pharmacokinetic equations	1
3	**UNIT III**	
	Calculus Differentiation : Introductions Derivative of a function, Derivative of a constant	1
	Derivative of a product of a constant and a function	1
	Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula	1
	Derivative of the quotient of two functions (Quotient formula) – Without Proof, Derivative of xn w.r.tx,where n is any rational number,	1
	Derivative of ex,, Derivative of loge x , Derivative of ax, Derivative of trigonometric functions from first principles (without Proof),	1
	Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application	1
4	**UNIT IV**	
	Analytical Geometry Introduction: : Signs of the Coordinates, Distance formula, Straight Line	1
	Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines,	1
	Slope of a line joining two points, Slope – intercept form of a	1

	straight line	
	Integration: Introduction, Definition, Standard formulae,	1
	Rules of integration , Method of substitution	1
	Method of Partial fractions, Integration by parts, definite integrals, application	1
5	**UNIT V**	
	Differential Equations : Some basic definitions, Order and degree	1
	Equations in separable form , Homogeneous equations,	1
	Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations	1
	Laplace Transform : Introduction, Definition, Properties of Laplace transform,	1
	Laplace Transforms of elementary functions, Inverse Laplace transforms,	1
	Laplace transform of derivatives, Application to solve Linear differential equations,	1
	Application in solving Chemical kinetics and Pharmacokinetics equations	1
TOTAL NUMBER OF HOURS		**30**

QUESTION BANK

Q.	**Long Answers**
1.	Define matrices and discuss in detail the classification of matrices.
2.	If $A = \begin{bmatrix} 1 & -2 \\ -3 & -1 \end{bmatrix}$; $B = \begin{bmatrix} 4 & 2 & -5 \\ 1 & 0 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 6 & -7 & 0 \\ -1 & 2 & 5 \\ 1 & 0 & 3 \end{bmatrix}$ Then, verify (AB) C = A (BC)
3.	(i) If f (x) = ax^2+bx+3 and f (1) = 4, f (2) = 11. Find 'a' and 'b' (ii) If $y = f(x) = \frac{2x-3}{3x-2}$ then prove that $x = f(y)$
Q.	**Short Answer (Any Four) (4 x 5)**
1.	Find matrix 'x' if, $\begin{bmatrix} 4 & 5 \\ -3 & 6 \end{bmatrix} + x = \begin{bmatrix} 10 & -1 \\ 0 & -6 \end{bmatrix}$
2.	Find K, if the slope of line passing through the points (3, -5) and (K, -1) in 1/3.
	Find the slope of the line passing through the points (1, 1) and (3, 3).
3.	Define differential equation and order of differential equation.
4.	Write the in the logarithmic form: $5^4 = 625$
5.	Resolve into partial fraction $\frac{2x-3}{(x^2-1)(x+1)}$
6.	Resolve: $\frac{x^2+4x+1}{(x-1)(x+1)(x+3)}$
7.	Find $\frac{dy}{dx}$ if $y = (x+1)(x+2)$
8.	Find $\frac{dy}{dx}$ if $y = (\sqrt{x} + \frac{1}{\sqrt{x}})^2$
9.	Calculate the pH of a buffer solution containing 0.2 moles of acetic acid and 0.02 moles of potassium acetic acid per line. The dissociation constant of acetic acid is 1.85×10^{-6}.
10.	What is a function? Give detailed classification of functions.

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