

HUMAN ANATOMY, PHYSIOLOGY AND PATHOPHYSIOLOGY I (PRACTICAL)

Course Code: BP109P

Bachelor of Pharmacy (B.Pharm) | First Year, Semester I
As per the new Pharmacy Council of India (PCI) Syllabus 2026 (NEP 2020)

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Preface

The study of Human Anatomy, Physiology, and Pathophysiology forms the cornerstone of pharmaceutical education. A sound understanding of the normal structure and functions of the human body, along with the mechanisms underlying disease processes, is essential for every pharmacy student. Practical training complements theoretical learning by enabling students to observe, perform, and interpret various experimental procedures, thereby strengthening their scientific knowledge and technical skills.

This book, **Human Anatomy, Physiology and Pathophysiology I (Practical)**, has been meticulously prepared in accordance with the **New PCI Syllabus 2026 (NEP 2020)** for **BP109P**. It aims to provide students with a comprehensive practical manual that is simple to understand, scientifically accurate, and aligned with the latest educational framework prescribed by the Pharmacy Council of India.

The manual has been designed to facilitate experiential learning through well-structured practical exercises, clear objectives, systematic procedures, observation tables, and viva-voce questions. Each experiment has been presented in a concise yet comprehensive manner to help students develop practical competence while understanding the clinical relevance of human anatomy, physiology, and pathophysiology. Care has also been taken to ensure that the content promotes analytical thinking, problem-solving skills, and a scientific approach towards laboratory practices.

This practical textbook will serve as a valuable resource for Bachelor of Pharmacy students, helping them prepare for laboratory sessions, practical examinations, and future professional responsibilities in pharmacy and healthcare. Faculty members may also find it useful as a reference guide for conducting practical classes in a structured and outcome-based manner.

We sincerely hope that this book fulfills the academic expectations of students and teachers alike. We would be grateful to receive constructive suggestions and feedback from readers, which will help us improve future editions of this book.

We express our heartfelt gratitude to our colleagues, students, reviewers, and well-wishers for their constant encouragement and valuable support during the preparation of this manuscript. We also extend our sincere appreciation to **Wiseleaf Scientific Ventures Private Limited** for their cooperation and commitment towards the publication of quality academic resources.

We trust that this book will make a meaningful contribution to pharmacy education and inspire students to develop a deeper understanding of the fascinating science of the human body.

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Course Information and Syllabus

Field	Details
Course Code	BP109P
Course Title	Human Anatomy, Physiology and Pathophysiology I (Practical)
Course Type	Core
Credit	1
Hours per week (L-T-P)	0-0-3
Maximum hours	45
Maximum marks	50 (Sessional Exam 20 + End-Semester Exam 30)

Course Objectives

1. Provide fundamental knowledge of the structure and functions of the various organ systems of the human body.
2. Understand the mechanisms of homeostasis and their role in maintaining normal physiological function.
3. Introduce the basic concepts of pathophysiology and the causes of diseases affecting different organ systems.
4. Explain the body's physiological responses to disease-producing agents.
5. Lay the foundation for understanding clinical conditions through the study of functional alterations in organs and systems.

Course Outcomes (CO)

CO	On completion of this course, the student will be able to:
CO1	Explain the principles, applications and experimental use of microscopy, and perform basic laboratory experiments related to the nervous system and special senses.
CO2	Describe the gross morphology, microscopic structure and coordinated functioning of major human organs and organ systems, emphasising their roles in maintaining normal physiology.
CO3	Estimate and interpret key haematological parameters, and explain the mechanisms of homeostasis along with related physiological and pathological disorders.
CO4	Discuss the etiology and pathogenesis of selected disease states, linking structural and functional changes to clinical manifestations.
CO5	Identify and explain common diseases with respect to their signs and symptoms, risk factors, diagnostic methods, preventive measures, treatment strategies and possible complications.

List of Practicals (minimum 12 to be performed)

Exp. No.	Title of the experiment
1	Study of the compound microscope.
2	Microscopic study of epithelial and connective tissue.
3	Microscopic study of muscular and nervous tissue.
4	Identification of axial bones.
5	Identification of appendicular bones.
6	Introduction to haemocytometry.
7	Demonstration of total blood count by cell analyser.
8	Enumeration and interpretation of white blood cell (WBC) count and differential count.
9	Enumeration and interpretation of total red blood corpuscle (RBC) count.
10	Determination of bleeding time and clotting time.
11	Estimation and interpretation of haemoglobin content.
12	Determination of blood group.
13	Determination and interpretation of erythrocyte sedimentation rate (ESR).
14	Determination of pulse rate, heart rate and blood pressure.
15	Recording and interpretation of ECG.
16	Study of the cardiovascular system and integumentary system.
17	Case studies of patients with anaemia, thalassaemia, haemophilia, leprosy, gout, hypertension and ischaemic heart disease.

General Laboratory Instructions and Safety

Conduct in the laboratory

- Report to the laboratory on time wearing a clean, buttoned white apron and covered footwear.
- Bring the practical record, observation notebook, pencil, eraser and the prescribed textbook to every session.
- Read the aim, principle and procedure of the day's experiment before entering the laboratory.
- Keep the working bench clean, dry and free of unnecessary articles; do not eat, drink or apply cosmetics in the laboratory.
- Handle microscopes, glassware and instruments carefully; report any breakage or malfunction to the teacher immediately.

Handling of blood and body fluids (biosafety)

- Treat every blood sample as potentially infectious; follow universal precautions at all times.
- Use a sterile, disposable lancet for each finger prick and never re-use or share lancets.
- Clean the fingertip with 70% alcohol (spirit) swab before pricking and allow it to dry.
- Wear disposable gloves while handling blood; discard used lancets and sharps into the puncture-proof sharps container.
- Discard blood-soiled cotton, slides and pipettes into the biohazard (colour-coded) waste bag, not the general bin.
- Wash hands with soap and running water before leaving the laboratory.

Reagents and instruments

- Label all reagent bottles; use acids (e.g., N/10 HCl in the haemocytometer) with care and avoid skin contact.
- Rinse haemocytometer pipettes and the counting chamber immediately after use and dry them before storage.
- Switch off electrical instruments (colorimeter, cell counter, ECG machine) after use and cover them.

Writing the practical record

- Each experiment is recorded under the standard headings: Aim, Requirements, Principle, Procedure, Observation, Result, Precautions and Viva-voce.
- Enter observations directly into the ruled observation table in ink; do not use loose sheets.
- State every result with its unit and compare it with the normal reference range.
- Get the record signed by the teacher at the end of each session.

Introduction: Composition and Functions of Blood

Many of the experiments in this course are performed on blood, so a short account of its composition and functions is given here as a foundation for the practical work that follows.

Blood as a tissue

Blood is a fluid connective tissue that circulates continuously through the heart and blood vessels. An adult has about 5 to 6 litres of blood, roughly 8% of the body weight. It consists of a straw-coloured fluid, the plasma, in which the formed elements (the blood cells) are suspended. When blood is centrifuged, the plasma forms about 55% of the volume and the cells about 45%; the proportion of the volume occupied by the red cells is called the haematocrit or packed cell volume.

Plasma

- **Water (about 90%):** the solvent in which everything else is dissolved or suspended.
- **Plasma proteins:** albumin (maintains osmotic pressure), globulins (antibodies and transport) and fibrinogen (essential for clotting).
- **Nutrients, wastes and gases:** glucose, amino acids, lipids, urea, oxygen and carbon dioxide.
- **Electrolytes and hormones:** sodium, potassium, calcium, bicarbonate and the circulating hormones.

The formed elements

Formed element	Normal number	Chief function
Red cells (erythrocytes)	Male 4.5-6.5, Female 3.8-5.8 million/ μ L	Carry oxygen and carbon dioxide (contain haemoglobin)
White cells (leucocytes)	4,000-11,000 / μ L	Defence against infection and immunity
Platelets (thrombocytes)	1.5-4.5 lakh/ μ L	Haemostasis and blood clotting

Functions of blood

- **Transport:** of oxygen and carbon dioxide, nutrients, waste products, hormones and enzymes.
- **Regulation:** of body temperature, of the water and electrolyte balance, and of the acid-base balance (pH) of the tissues.
- **Protection:** against infection by the white cells and antibodies, and against blood loss by clotting.

Formation of blood cells (haemopoiesis)

In the adult, the blood cells are formed in the red bone marrow. Red-cell formation (erythropoiesis) is stimulated by the hormone erythropoietin from the kidney and requires iron, vitamin B12 and folic acid. Red cells live about 120 days, after which they are broken down in the spleen and liver, and the iron is recycled. A disturbance of these processes underlies many of the disorders studied later, such as anaemia.

Experiment 1: Study of the Compound Microscope

Aim

To study the different parts of a compound microscope, understand their functions, and learn the correct method of handling, focusing and care of the instrument.

Requirements

- Compound (light) microscope
- A prepared/permanent stained slide
- Lens-cleaning (lens) paper and a soft dust cloth
- Cedar-wood or synthetic immersion oil
- Xylene (for cleaning the oil-immersion lens)

Principle

The compound microscope is the fundamental tool of biological and pharmaceutical laboratories. It is used to examine structures that are far too small for the unaided eye, such as tissues, blood cells, micro-organisms and crystals of drugs. The word "compound" refers to the use of more than one lens system in series, which multiplies the magnifying effect and allows very high magnification with useful resolution.

- **Definition:** a compound microscope is an optical instrument that produces a greatly enlarged image of a minute object with the help of two lens systems, the objective and the eyepiece, arranged at the two ends of a body tube.
- **Two-stage magnification:** light from the illuminated object passes through the objective, which forms a real, inverted and magnified image inside the tube; the eyepiece then treats this image as its object and forms a further magnified, virtual image that the eye perceives.
- **Total magnification:** it is the product of the magnifying power of the objective and that of the eyepiece. Thus a 10X objective with a 10X eyepiece gives 100X, a 40X objective with a 10X eyepiece gives 400X, and a 100X oil-immersion objective with a 10X eyepiece gives 1000X.
- **Resolving power:** the capacity of the microscope to reveal two closely placed points as separate. It depends on the wavelength of light used and the numerical aperture (NA) of the objective, and is expressed by the relation $d = 0.61 \lambda / NA$, where d is the smallest resolvable distance. A high magnification without adequate resolving power gives only a large but blurred image (empty magnification).
- **Numerical aperture (NA):** a measure of the light-gathering ability of the objective; a higher NA gives better resolution. Immersion oil, whose refractive index is close to that of glass, is used with the 100X objective to raise the effective NA and prevent loss of light by refraction.

The parts of the microscope are conveniently grouped into a mechanical system, which supports and moves the specimen and the lenses, and an optical system, which illuminates the specimen and forms the image.

Part	System	Function
Base and pillar	Mechanical	Support the whole instrument on the bench.
Arm	Mechanical	Curved handle for carrying and for holding the tube and stage.
Stage with clips	Mechanical	Flat platform on which the slide is placed and held; has a central aperture for light.
Body tube and draw tube	Mechanical	Hold the eyepiece above and the objectives below at the correct tube length.
Revolving nosepiece	Mechanical	Carries the objectives and allows each to be swung into position.

Coarse and fine adjustment	Mechanical	Raise or lower the tube/stage to focus; coarse for approximate, fine for sharp focus.
Mirror or built-in illuminator	Optical	Directs light up through the condenser to the specimen.
Condenser and iris diaphragm	Optical	Concentrate the light on the specimen and control the intensity and contrast.
Objectives (10X, 40X, 100X)	Optical	Form the primary magnified image; the 100X is used with oil immersion.
Eyepiece (ocular, 10X)	Optical	Further magnifies the image for the eye.

COMPOUND MICROSCOPE

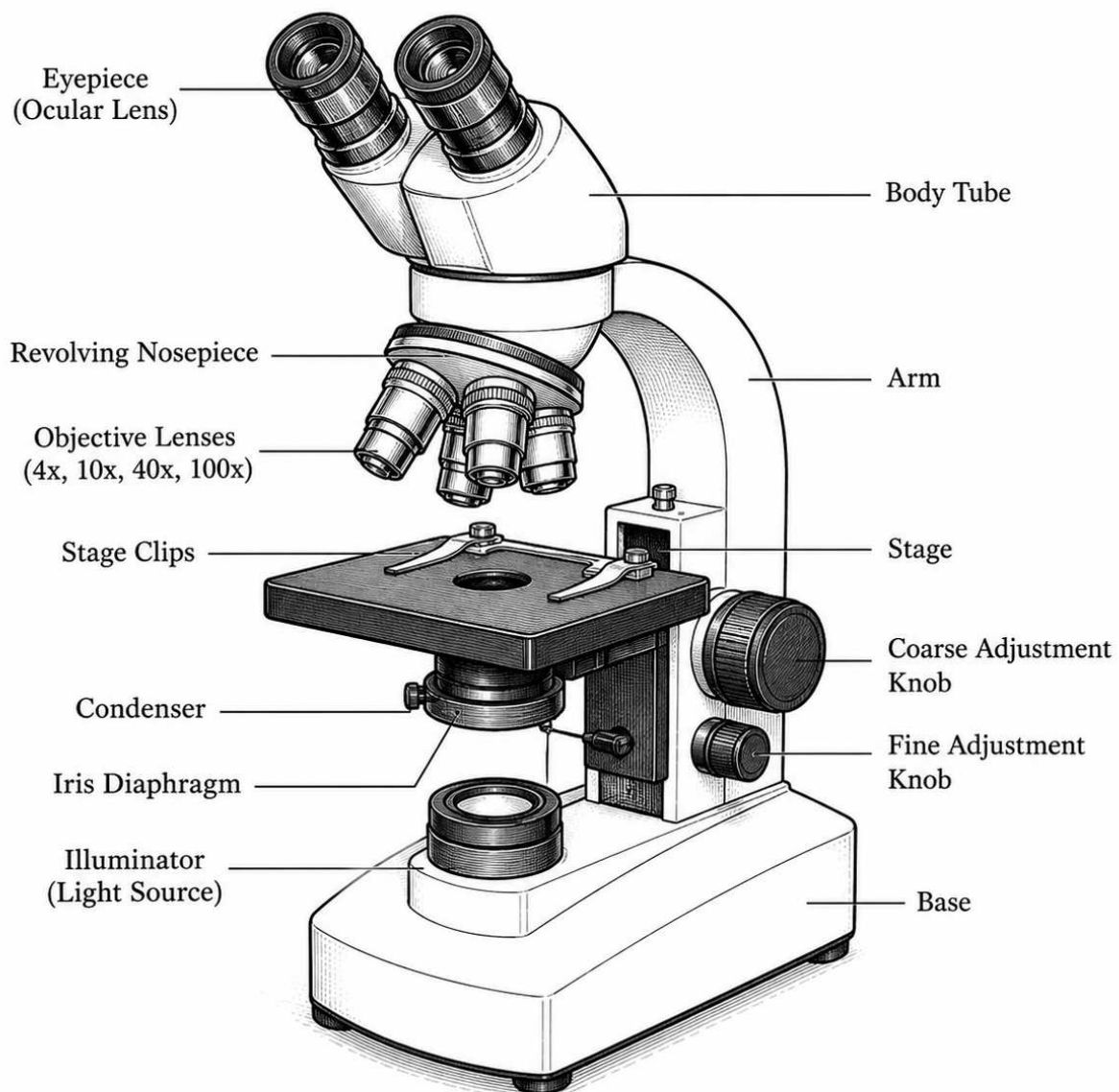


Fig 1.1 Parts of a compound microscope.

Procedure

1. Carry the microscope with one hand supporting the base and the other holding the arm; place it gently on a firm, level bench with the arm towards you and the stage away.
2. Adjust the mirror (or switch on the built-in illuminator) and open the diaphragm to obtain a uniformly bright, evenly illuminated field when viewed through the eyepiece.
3. Place the prepared slide on the stage, cover-slip upwards, and secure it under the clips with the specimen exactly over the central aperture.
4. Rotate the low-power (10X) objective into the optical axis until it clicks into place.
5. Watching from the side, lower the objective close to the slide with the coarse adjustment; then, looking through the eyepiece, raise it slowly with the coarse knob until the image appears, and sharpen it with the fine adjustment.
6. Adjust the condenser height and the iris diaphragm to obtain the best contrast without glare.
7. To examine detail, swing the high-power (40X) objective into place; the image will be nearly in focus (parfocal) and needs only the fine adjustment.
8. For the highest magnification, place a small drop of immersion oil on the illuminated part of the slide, swing the 100X objective into the oil, and focus with the fine adjustment only.
9. After use, raise the tube, remove the slide, wipe the 100X objective and the slide free of oil with lens paper moistened with xylene, rotate the low-power objective into place, centre the nosepiece and cover the microscope with its dust cover.

Care and maintenance of the microscope

- Keep the microscope in a dust-free cabinet with a desiccant (silica gel) to prevent fungal growth on the lenses, which is common in humid climates.
- Clean the lenses only with lens paper; grease and fingerprints are removed with a trace of xylene, never with alcohol on cemented lenses.
- Do not force the coarse adjustment; if focusing is stiff, report it rather than applying pressure.
- Always leave the low-power objective in position and the tube at its lowest safe point after use.

Applications in pharmacy

A working knowledge of the compound microscope underlies several areas of pharmacy: the microscopic (pharmacognostic) identification of crude drugs and adulterants, the examination of blood and other cells in physiology and pathology, the study of microbial morphology in microbiology, the determination of particle size and crystal habit of drug powders, and the routine quality control of pharmaceutical preparations.

Observation

Record the magnification obtained with each objective and identify the labelled parts of the microscope in the diagram.

S. No.	Objective used	Objective power	Eyepiece power	Total magnification
1				
2				
3				

Result

The parts of the compound microscope and their functions were studied, and the technique of focusing under low power, high power and oil immersion was performed.