

Pharmaceutical Analysis (Theory) BP605T

A Textbook for B. Pharm Semester VI
*As per the new Pharmacy Council of India (PCI) Syllabus
2026 (NEP 2020)*

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Preface

Pharmaceutical Analysis (BP605T) is, in essence, the study of how the quality of a medicine is measured. The subject gathers together the instrumental methods by which a drug is identified, its amount determined, and its impurities controlled, and it asks the student to understand not only how each instrument works but also when each method should be chosen. This book is written to teach exactly that, to the depth that the examination demands and no further, in clear and orderly language.

The book follows the five units of the syllabus. The first unit treats the electrochemical methods, potentiometry, conductometry, and polarography. The second and third units treat the spectroscopic methods, from the fundamentals of electromagnetic radiation through ultraviolet-visible, infrared, and fluorescence spectroscopy to the atomic methods and the scattering methods. The fourth and fifth units treat the separation methods, from the classical chromatographic and electrophoretic techniques to the modern instrumental forms, gas chromatography, high-performance liquid chromatography, and high-performance thin-layer chromatography.

Each chapter is built to the same plan. It opens with the principle of the method, sets out the instrumentation as a clearly labelled block diagram, explains the working step by step, and closes with the pharmaceutical applications, the merits, and the limitations. Worked examples and quick-recall boxes mark the points that are most often misunderstood or most often examined. Every chapter ends with a full set of self-assessment questions, short-answer and long-answer questions with model answers, numerical problems worked in full, and a set of multiple-choice questions, all framed in the style of the university paper, so that the book serves as both a text and a question bank. A student who studies this book and works its questions should be well prepared for the BP605T paper.

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Acknowledgement

We express our sincere gratitude to all those who have directly and indirectly contributed to the successful preparation of this book, **BP605T – Pharmaceutical Analysis**, developed in accordance with the **Pharmacy Council of India (PCI) NEP 2026 curriculum** for the Bachelor of Pharmacy programme.

The primary objective of this book is to provide students with a comprehensive, concept-oriented, and application-based understanding of pharmaceutical analysis. Keeping in view the vision of the **National Education Policy (NEP) 2020** and the **PCI NEP 2026 syllabus**, every effort has been made to present the subject in a simple, systematic, and student-friendly manner, promoting analytical thinking, scientific inquiry, and competency-based learning.

We extend our heartfelt appreciation to our colleagues, faculty members, students, and academic peers whose valuable suggestions, encouragement, and constructive feedback have significantly contributed to the preparation and refinement of this book. Their support has been invaluable in enhancing its quality and relevance.

We also acknowledge the use of standard reference books, the **Indian Pharmacopoeia**, and other authentic scientific resources that have served as reliable references in the preparation of the content. These sources have helped ensure the accuracy, scientific integrity, and academic excellence of this work.

It is our sincere hope that this book will serve as a valuable resource for undergraduate pharmacy students, teachers, and researchers by strengthening their understanding of pharmaceutical analysis and equipping them with the knowledge and skills required for quality control, quality assurance, regulatory compliance, and pharmaceutical research.

We welcome constructive suggestions and feedback from readers, which will be highly appreciated and considered for improving future editions of this book.

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Course Objectives

The objectives of this course are to:

1. Understand the interaction of matter with electromagnetic radiation and its application in spectroscopic methods for pharmaceutical drug analysis.
2. Study the principles, instrumentation, and pharmaceutical applications of electroanalytical techniques such as potentiometry, conductometry, polarography, and amperometry.
3. Understand and apply various chromatographic and electrophoretic separation techniques used for qualitative and quantitative analysis of drugs.
4. Impart knowledge of instrumental methods used for accurate qualitative and quantitative analysis of pharmaceutical substances.
5. Develop the ability to select, optimize, and validate suitable analytical techniques, interpret analytical data.

Course Outcomes

Upon successful completion of this course, the students will be able to:

1. Explain the theoretical basis of electrochemical methods (potentiometry, conductometry, polarography, amperometry) and spectroscopic techniques (UV-Visible, IR, fluorometry, atomic absorption).
2. Explain the instruments involved in electroanalytical and spectroscopic methods.
3. Describe the principles, instrumentation, and applications of various chromatographic and electrophoretic techniques.
4. Select suitable analytical techniques for specific pharmaceutical analysis requirements.
5. Analyze, interpret, and report analytical data accurately and draw meaningful conclusions.

Syllabus

Unit	Topics	No. of lectures
I	Electrochemical Methods of Analysis a) Potentiometry: Electrode potential, electrochemical cell, construction and working of reference and indicator electrodes including membrane electrodes, measurement of potential and pH, potentiometric titrations, methods of detecting end point and Karl Fischer titration. b) Conductometry: Introduction, conductivity cell, conductometric titrations and applications. c) Polarography: Introduction, residual current, migration current, diffusion current and limiting current, DME, polarographic wave, Ilkovic's equation (Statement Only), and applications.	10 Hours
II	Spectroscopy a) Fundamentals of Spectroscopy: Properties of electromagnetic radiation, electromagnetic spectrum. b) UV-Visible spectroscopy: Beer and Lambert's law, derivation and deviations. Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra. Instrumentation - sources of radiation, wavelength selectors, sample cells, detectors (photo tube, photomultiplier tube, photovoltaic cell, silicon photodiode). Applications - single and multi component analysis of pharmaceuticals. c) IR spectroscopy: Introduction, fundamental modes of vibrations in polyatomic molecules, factors affecting vibrations, instrumentation of dispersive infrared spectrophotometer (including sample handling techniques) and FTIR. Pharmaceutical applications.	10 Hours
III	a) Fluorimetry: Theory, luminescence, factors affecting fluorescence, quenching. Instrumentation and pharmaceutical applications. b) Flame Photometry and Atomic Absorption Spectrometry: Theory, nebulisation, flame and flame temperature, interferences, instrumentation and pharmaceutical applications. c) Nephelo-turbidimetry: Principle, instrumentation and applications.	07 Hours
IV	Introduction to Chromatographic Techniques a) Principle, various stationary and mobile phases, diverse development and detection techniques and applications of column, paper and thin layer chromatography. b) Ion-exchange chromatography: Introduction, principles, types of ion exchange resins, factors affecting ion exchange, methodology and applications. c) Gel filtration and affinity chromatography: Principles and applications. d) Electrophoresis: Introduction, factors affecting electrophoretic mobility, techniques of paper, gel, capillary electrophoresis, applications.	08 Hours
V	a) Gas chromatography: Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications. b) High performance liquid chromatography: Introduction, theory, instrumentation, advantages and applications. c) HPTLC: Principle, instrumentation and applications.	10 Hours

How to Use This Book

Read for the principle first. Before memorising an instrument, make sure the principle is clear: what physical signal is measured, how that signal is related to the amount of the substance, and what interferes. Every later detail hangs on this.

Learn each instrument as a block diagram. For every method, learn the chain source, sample, discriminator or separator, detector, readout, and be able to draw and label it. The block diagram is the backbone of almost every long-answer question on instrumentation.

Use the quick-recall boxes and the high-yield tags. The shaded quick-recall boxes hold the single most examinable fact of a section. The high-yield notes at the end of each self-assessment point to the topics that the paper returns to most often.

Work every numerical with the units written in. The worked examples and numerical problems are solved in full, with the units carried through every step. Reproduce them on paper rather than reading them, because the paper rewards the method as much as the answer.

Answer the questions to the mark scheme. The model answers to the long-answer questions list what earns the marks, the definition, the classification, the labelled diagram, the mechanism, the example. Practice giving answers in that shape.

Cross-refer. Where a topic depends on an earlier one, the text says so. Follow the cross-reference rather than relearning the earlier idea; the book is built so that each concept is explained once and then used.

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