PHARMACY COUNCIL OF INDIA

SYLLABUS

BACHELOR OF PHARMACY (B. Pharm)

(2026)

As per NEP 2020





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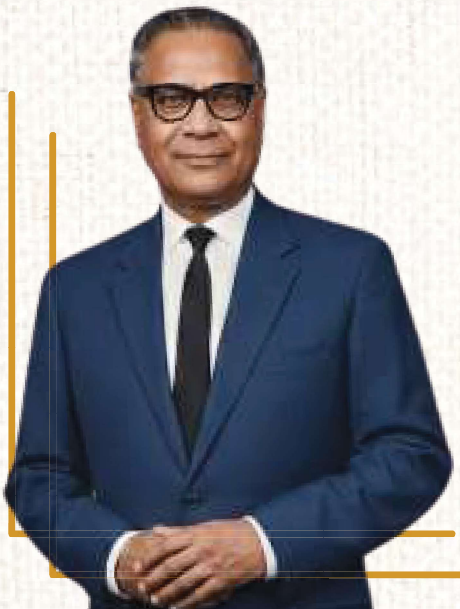
I-300, 3rd floor, Tower-I, World Trade Centre, Nauroji Nagar,
New Delhi 110 029.

A TRIBUTE TO
PROFESSOR MAHADEVA LAL SCHROFF

Professor Mahadeva Lal Schroff, revered as the Father of Pharmaceutical Education in India, was a visionary whose pioneering efforts laid the foundation of structured pharmacy education in the country. His unwavering commitment to academic excellence, professional ethics, and scientific advancement transformed pharmacy from a trade into a respected profession rooted in knowledge, innovation, and research.

Through his relentless dedication, Professor Schroff, introduced formal pharmacy education and emphasized the importance of quality, innovation, and patient-centered care. His contributions not only shaped the academic framework of pharmacy education but also strengthened its role in advancing healthcare in India. His legacy continues to inspire generations of pharmacists, educators, and researchers to uphold excellence and contribute meaningfully to healthcare.

This syllabus stands as a tribute to his enduring vision—reflecting a commitment to empowering pharmacy education, fostering research, and advancing innovation in alignment with the evolving needs of society and the profession.



डॉ. मोंटूकुमार एम. पटेल
अध्यक्ष
DR. MONTUKUMAR M. PATEL
President

भारतीय भेषजी परिषद्
Pharmacy Council of India
(Ministry of Health & Family Welfare, Govt. of India)

17/04/2026

Dear Esteemed Colleagues, Faculty, Students, and Stakeholders in Pharmacy Education

It gives me great pleasure to present the Bachelor of Pharmacy (B.Pharm) syllabus, proposed for implementation from the academic year 2026–27. This curriculum has been developed in alignment with the vision of the National Education Policy (NEP) 2020, to strengthen pharmacy education and prepare graduates to meet the evolving needs of healthcare and the pharmaceutical sector.

The syllabus places strong emphasis on scientific fundamentals, practical and experiential learning, research orientation, and the development of professional competencies essential for modern pharmacy practice. It also introduces emerging areas, including Artificial Intelligence (AI) and latest digital technologies, enabling students to understand their applications in fields such as drug discovery, pharmaceutical manufacturing, pharmacokinetics, and pharmacy practice, while remaining firmly grounded in the core pharmaceutical sciences.

The curriculum also offers greater academic flexibility through elective courses, along with opportunities for projects, internships and industry exposure. These features are intended to equip students with broader perspectives and practical competence, preparing them to contribute effectively to healthcare, research, industry, and regulatory services.

I sincerely acknowledge the valuable contributions of the Education Regulations Committee (ERC), subject experts, academic leaders, and industry representatives whose collective efforts have shaped this curriculum. Their dedication has been instrumental in developing a syllabus that reflects both academic strength and the emerging needs of the profession.

I wish all institutions, faculty members, and students every success in implementing this curriculum and in advancing the future of pharmacy education in India.

DR. MONTUKUMAR M. PATEL
President, Pharmacy Council of India

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GRADUATE ATTRIBUTES (GA's)

Graduate Attributes (GAs) represent the key competencies and professional qualities expected from every pharmacy graduate, irrespective of the program such as D.Pharm, B.Pharm,Pharm.D or M.Pharm. While the level of mastery may vary, these attributes remain common and guide the overall outcomes of pharmacy education.

1. **Pharmaceutical Knowledge Proficiency**

   – Strong grounding in core and applied pharmaceutical sciences and practice.

2. **Scientific and Analytical Thinking**

   – Ability to critically analyze data, processes, and clinical information.

3. **Ethical and Professional Integrity**

   – Commitment to ethical conduct, patient safety, and regulatory compliance.

4. **Patient-Centered Orientation**

   – Sensitivity to patient needs, cultural diversity, and healthcare outcomes.

5. **Industry and Practice Readiness**

   – Preparedness for roles in industry, hospitals, community pharmacy, research, and regulation.

6. **Digital and Technological Awareness**

   – Familiarity with AI, data analytics, automation, and modern pharmaceutical technologies.

7. **Effective Communication Skills**

   – Clear, empathetic, and professional interaction across healthcare settings.

8. **Teamwork and Leadership Skills**

   – Ability to collaborate, lead, and contribute constructively in teams.

9. **Innovation and Problem-Solving Mindset**

   – Capability to identify problems and develop practical, evidence-based solutions.

10. **Lifelong Learning Orientation**

    – Motivation for continuous professional development and higher education.

PROGRAMME EDUCATIONAL OBJECTIVES

The Bachelor of Pharmacy (B. Pharm) programme aims to prepare graduates with strong knowledge of pharmaceutical sciences, practical skills, professional ethics, and a commitment to patient care and public health. The graduates of the programme are expected to achieve the following Programme Educational Objectives (PEOs):

PEO 1: Apply fundamental knowledge of pharmaceutical sciences to work effectively in pharmacy practice, pharmaceutical industry, research, and related healthcare fields.

PEO 2: Demonstrate practical skills in drug formulation, manufacturing, pharmaceutical analysis, quality control, and pharmacy practice.

PEO 3: Use scientific reasoning and problem-solving skills to address challenges related to medicines, drug development, and patient care.

PEO 4: Practice pharmacy with ethical responsibility, good communication, teamwork, and concern for patient safety and public health.

PEO 5: Pursue continuous learning and professional development to keep pace with advances in pharmaceutical sciences and healthcare.

PROGRAMME OUTCOMES (POs)

Bachelor of Pharmacy (B. Pharm)

PO1. Pharmacy Knowledge

Apply comprehensive knowledge of pharmaceutical sciences, biomedical sciences, pharmacology, pharmacognosy, pharmaceutical chemistry, pharmacy practice, and manufacturing processes to understand drug actions, disease mechanisms, and therapeutic interventions and solve professional problems across diverse pharmacy domains.

PO2. Problem Analysis, Critical Thinking and Evidence-Based Decision Making

Identify, formulate, analyze, and interpret complex pharmaceutical problems using principles of scientific inquiry, critical thinking, biostatistics, and evidence-based reasoning to arrive at defensible solutions and informed decision-making.

PO3. Pharmaceutical Skills & Practice

Demonstrate proficiency in formulation development, analysis, quality assurance, pharmacovigilance, clinical pharmacotherapy, and pharmacy practice through laboratory work, simulations, internships, and experiential learning.

PO4. Modern Tools, AI & Digital Competence

Select, apply, and evaluate modern pharmaceutical tools, analytical instruments, digital technologies, artificial intelligence, machine learning, and computational techniques with awareness of their limitations and ethical use.

PO5. Research & Innovation

Design and conduct basic research, analyze data, interpret results, and contribute to innovation through research projects, startup initiatives, and problem-based learning relevant to industry, healthcare, and society.

PO6. Professional Ethics & Human Values

Apply ethical principles, professional integrity, regulatory frameworks, intellectual property rights, and universal human values while addressing professional, legal, and societal responsibilities in pharmacy practice.

PO7. Communication & Interpersonal Skills

Communicate effectively with patients, healthcare professionals, industry personnel, and society through clear documentation, reports, presentations, counseling, teamwork, and interdisciplinary collaboration.

PO8. Leadership, Management & Entrepreneurship

Demonstrate leadership, teamwork, planning, and managerial skills in pharmaceutical organizations, healthcare systems, quality systems, and entrepreneurial ventures, including innovation and startup ecosystems.

PO9. Pharmacist & Society

Evaluate public health, patient safety, legal, and societal issues related to pharmacy practice and contribute responsibly to healthcare delivery, rational use of medicines, and improvement of community health outcomes.

PO10. Environment and sustainability:

Recognize and address the environmental impact of pharmaceutical manufacturing, use, and disposal, and promote environmentally responsible practices, green pharmacy principles, and sustainable healthcare aligned with the United Nation's Sustainable Development Goals (SDGs).

PO11. Life-Long Learning & Professional Development

Recognize the need for continuous learning and demonstrate the ability to engage in self-directed, life-long learning to adapt to technological advancements, evolving healthcare needs, and professional growth.



वयमत्रे दु आतप्तानाम् प्रतिक्रियार्तिनाशकम्

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 counselling of patients.

I shall endeavour 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 !

GLOSSARY

KEYWORD	DEFINITION
Ability Enhancement Courses	Courses of varying durations which are optional, and offered in the curriculum that improves the understanding of the subject and enhance ability of the students.
Academic Calendar	The schedule of the institution for the academic year, giving details of all academic and administrative events.
Assessment	Performance evaluation based on certain established criteria
Attainment of Course Outcomes (COs)	COs are to be attained by all students at the end of a formal course. While the method of computation of attainment of COs is not unique, each institution has to follow a well-defined direct method of computing CO attainment based on the student performance in all assessment instruments, and indirect method of computing COs through course exit survey of students
Bloom's Taxonomy	A hierarchical framework used to classify educational learning objectives into levels of complexity and specificity, utilized here to design question papers and assessment tools.
Choice Based Credit System (CBCS)	A mode of learning in higher education which facilitates a student to have some freedom in selecting his/her own choices, across various disciplines for completing a UG / PG program. All UG and PG programs, as per UGC, have to implement CBCS
Co-Curricular Activities	Activities, which support the curriculum such as field trips, hospital visits, community medicine shops, display of academic achievements, quiz, debate, discussion, seminars, role-play, etc
Collaboration	Formal agreement/ understanding between any two or more institutions for training, research, student/ faculty exchange or extension support.
Continuous Assessment	A component of internal assessment that evaluates regular engagement, including attendance and student-teacher interaction.
Counseling	Assisting and mentoring students individually or collectively for academic, career, personal and financial decision-making.

Course	A course is a unit of 1 to 6 credits in a formal program. A 3-credit course will have three classroom sessions of one-hour duration during each week for the entire semester.
Course Outcomes (COs)	COs are statements that describe what students should be able to do at the end of a course.
Credit	A credit system is a systematic way of describing an educational programme by attaching credits to its components as a unit of measure for academic work. One (1) credit is assigned for every one hour of lecture per week or every two hours of practical (laboratory) work per week. For internship and projects, 30 hours equals 1 credit.
Cumulative Grade Point Average (CGPA)	A calculation based on the SGPA of all eight semesters, used to determine the final class and rank.
E-learning Resources	Learning resources available on Internet
Elective Courses	A choice available to students to select from among a large number of Courses
Enrichment Courses	Value added courses offered by institution for student empowerment. They enhance the curriculum by amplifying, supplementing and replacing such parts or features as have become ineffective or obsolete.
Evaluation Process	Assessment of learning, teaching and evaluation process and reforms to increase the efficiency and effectiveness of the system.
Experiential Learning	Is a process of learning through experience and is more specifically defined as “learning through reflection on doing”.
Field Project	Formal projects students need to undertake that involve conducting surveys outside the college/university premises and collection of data from designated communities or natural places
Graduate Attributes	The disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents for social good in an unknown future.
Grievance Redressal	Mechanisms for receiving, processing and addressing dissatisfaction expressed, complaints and other formal requests

	made by learners, staff and other stakeholders on the institutional provisions promised and perceived.
ICT	Information and Communication Technology Consists of the hardware, software, networks and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images) as well as related services.
Internal Examination Committee	A body chaired by the Principal that plans the internal assessment calendar, approves question paper patterns, and addresses student grievances regarding internal marks.
Internship	A mandatory period of at least 120 hours of work in a pharmaceutical industry, hospital, or clinical research organization, typically completed after Semester V and VI under an identified mentor.
Learning Outcomes	Specific intentions of a Programme or module, written in clear terms. They describe what a student should know, understand, or be able to do at the end of that Programme or module
Levels of Outcomes	**Programme Educational Objectives (PEOs):** PEOs are broad statements that describe the professional achievements and career accomplishments that graduates are expected to attain a few years after completing the programme. **Programme Outcomes (POs):** POs are statements that describe the knowledge, skills, and competencies that students should acquire by the time they graduate from the programme. **Course Outcomes (COs):** COs are statements that describe what students should be able to know, understand, and perform at the end of a specific course.
Miller's Pyramid	A framework for assessing clinical competence, used to monitor the progress and attainment of pharmacy students.
Multi-disciplinary Courses	Courses of varying durations which are optional, and offered outside the curriculum in the multidisciplinary areas that

	encourage understanding of recent trends in allied areas and helping the students in getting placed.
OBE: Outcome Based Education	OBE is an educational theory that bases each part of an educational system around goals (outcomes). Each student should have achieved the goal by the end of the educational experience
Outcome	An outcome of an educational Programme is what the student should be able to do at the end of a Programme/ course/ instructional unit.
Participative Learning	Participatory Learning and Action is a family of approaches, methods, attitudes, behaviours and relationships, which enable and empower people to share, analyze and enhance their knowledge of their life and conditions, and to plan, act, monitor, evaluate and reflect.
Problem Based Learning (PBL)	Is a student-centred pedagogy in which students learn about a subject through the experience of solving an open-ended problem found in trigger material. The PBL process does not focus on problem solving with a defined solution, but it allows for the development of other desirable skills and attributes. This includes knowledge acquisition, enhanced group collaboration and communication.
Programme	A structured set of courses and learning experiences offered over a specified period, leading to the award of a certificate, diploma, or degree recognized by the appropriate regulatory authority (e.g., UGC/PCI).
Program Committee	A committee led by a senior teacher that reviews class progress, discusses curriculum issues, and monitors the attainment of program outcomes.
Remedial Courses	Courses offered to academically disadvantaged students in order to help them cope with academic requirements.
Research Project	A supervised project carried out in groups of no more than three students during the final year, relating to an elective subject.

Semester	A period of study consisting of not less than 90 working days. Odd semesters run from June/July to November/December, and even semesters run from December/January to May/June
Semester Grade Point Average (SGPA)	A number representing the weighted average of the grade points obtained in all courses during a single semester.
Sessional	Tests conducted for each course during the semester, the average of which contributes to the internal assessment marks.
Skill Enhancement Courses	Courses of varying durations which are optional, and offered in the curriculum that develop the required skills and helping the students in getting placed.
Progression	Vertical movement of students from one level of education to the next higher level successfully or towards gainful employment.
Value Added Courses	Courses of varying durations which are optional, and offered outside the curriculum that add value and helping the students in getting placed.

Semester II

Course Code	Name of the course		No. of hours per week (L/P)	Credit points
BP201T	Applied Biostatistics and Data Analytics for Pharmaceutical Sciences (Theory)		2	2
BP202T	Biochemistry (Theory)		3	3
BP203T	Human Anatomy, Physiology and Pathophysiology II (Theory)		4	4
BP204T	Pharmaceutical Organic Chemistry (Theory)		4	4
BP205T	Pharmacognosy and Phytochemistry (Theory)		4	4
BP206T	Physical Pharmaceutics (Theory)		3	3
BP207P	Biochemistry (Practical)		3	1
BP208P	Human Anatomy, Physiology and Pathophysiology II (Practical)		3	1
BP209P	Pharmaceutical Organic Chemistry (Practical)		3	1
BP210P	Pharmacognosy and Phytochemistry (Practical)		3	1
BP211P	Physical Pharmaceutics (Practical)		3	1
BP212P SEC*	BP212P SEC1	Communication Skills	2	1
	BP212P SEC2	Mental Well-Being, Stress & Conflict Management		
	BP212P SEC3	Fundamentals of Computer Operations		
Total			**37**	**26**

* Only one elective course shall be selected
The syllabi for elective subjects are given in the *appendix*

Course Code	Course Title			Course Type
BP201T	**Applied Biostatistics and Data Analytics for Pharmaceutical Sciences (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
2	2	--	--	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain fundamental statistical concepts relevant to pharmaceutical sciences.
2. Develop the ability to interpret clinical and experimental data scientifically.
3. Apply statistical methods for analysing pharmaceutical and biomedical data.
4. Demonstrate the use of Python-based tools for statistical analysis and data handling.
5. Recognize the role of statistical analysis in evidence-based decision making and machine learning applications in healthcare.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Classify pharmaceutical data using appropriate descriptive statistics.
2	Apply probability concepts and statistical distributions in clinical and pharmaceutical contexts.
3	Perform sampling and hypothesis testing for decision-making in research.
4	Analyze correlation and regression relationships in pharmaceutical datasets.
5	Demonstrate statistical analysis using Python and interpret outputs appropriately.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Descriptive Statistics** • Types of data in pharmaceutical sciences (nominal, ordinal, interval, ratio) • Sources of data in pharmacy: clinical trials, pharmacovigilance, quality control, PK studies • Measures of central tendency: mean, median, mode, their calculation and interpretation	6 hours

	• Measures of dispersion (range, variance, standard deviation) and their interpretation using pharmaceutical data • Skewness and understanding distribution shape in biological measurements • Perform descriptive statistical analysis using Python libraries such as NumPy and Pandas, with focus on Interpretation of results	
II	**Probability & Statistical Distributions in Healthcare** • Basic probability concepts and laws (addition and multiplication rules), conditional probability and its interpretation • Bayes' theorem and its application in clinical decision-making • Concept of random variables (discrete and continuous) • Normal distribution and its importance in biological and pharmaceutical measurements, • Binomial distribution demonstrating applications in clinical trial outcomes • Poisson distribution for modeling rare events such as adverse drug reactions • Graphical visualization of these probability distributions using Python	6 hours
III	**Sampling & Statistical Inference** • Population versus sample, sampling techniques used in clinical research, Sampling error and bias • Conceptual understanding of the Central Limit Theorem • Confidence intervals and their interpretation • Hypothesis testing framework (null and alternative hypotheses) • Type I and Type II errors, p-value and statistical significance • Demonstration, calculation and interpretation of these parameters using python with pharmaceutical data	6 hours
IV	**Basics of Correlation & Regression** Conceptual understanding of the following concepts with emphasis on their interpretation- • correlation and Pearson correlation coefficients • Interpretation of positive and negative correlations • Scatter plots and trend visualization using pharmaceutical data such as dose-response relationships • Simple linear regression concept, interpretation of regression coefficients • Introduction to odds ratio and its application in clinical risk analysis	6 hours
V	**Statistical Analysis Using Python – Case based learning** • Demonstration of descriptive statistics, correlation analysis and linear regression using Python libraries- SciPy / Statsmodels / Scikit-learn on pharmaceutical datasets • Interpretation of the output summaries and p-values • Preparation of statistical reports	6 hours

Recommended References *(Preferably Latest Editions)*:

1. Lane, D.M., Introduction to Statistics. Houston: Rice University. Available at: https://onlinestatbook.com/2/index.html
2. Walters, S.J., Campbell, M.J. and Machin, D., Medical Statistics: A Textbook for the Health Sciences. Hoboken, NJ: Wiley-Blackwell.
3. Rowe, P., Essential Statistics for the Pharmaceutical Sciences. London: Pharmaceutical Press.
4. Bolton, S. and Bon, C., Pharmaceutical Statistics: Practical and Clinical Applications. New York: Informa Healthcare.
5. De Muth, J.E., Basic Statistics and Pharmaceutical Statistical Applications. Boca Raton, FL: CRC Press.

Course Code	Course Title			Course Type
BP202T	**Biochemistry (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES

The objectives of this course are to:

1. Know about enzymology and various tests in clinical chemistry
2. Understand the biochemical pathways and clinical relevance of carbohydrate, lipid and protein metabolism.
3. Describe energetics and biological oxidation.
4. Explain aminoacid and protein metabolism
5. Understand Nucleic acid metabolism and genetic information.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
CO1	Explain the principles ofenzymology and various tests in clinical chemistry
CO2	Describe the classification, the classification, structure, and functions of major biomolecules such as carbohydrates, lipids, proteins, nucleic acids, enzymes, and vitamins.
CO3	Explain the principles of bioenergetics, biological oxidation, and the overview of metabolic pathways of biomolecules, along with their clinical significance.
CO4	Understand metabolism of lipid and its significance.
CO5	Understand metabolism of proteins & its significance and monitoring of metabolic and organ-specific disorders.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Enzymology** a. Introduction, properties, nomenclature, and IUB classification of enzymes and coenzymes. Enzyme kinetics (Michaelis plot, Lineweaver–Burk plot). Enzyme inhibitors with examples. Regulation of enzymes: enzyme induction and repression, allosteric enzyme regulation.	10 hours

	Therapeutic and diagnostic application of enzymes and isoenzymes. Factors affecting enzyme activity. Digestion, absorption function of dietary Macro and Micronutrients, including Vitamins and Minerals, Biochemical functions of vitamins and associated diseases. b. Clinical Chemistry: Liver function tests (routinely performed tests based on liver function). Renal function tests (routinely performed tests based on kidney function, ELISA test)	
II	a. Introduction about biomolecules – Introduction of carbohydrate, lipids, nucleic acids, amino acids and proteins. b. Bioenergetics: Concept of free energy; relationship between free energy, enthalpy, and entropy; redox potential; energy-rich compounds (ATP, GTP, etc.) and their biological significance. c. Carbohydrate Metabolism and their role in diabetis mellitus: Overview and significance of major pathways: Glycolysis, Citric Acid Cycle (TCA), Gluconeogenesis, Hexose Monophosphate (HMP) shunt, and Glycogen metabolism; regulation of blood glucose levels; metabolic adaptations during fed state, fasting, and prolonged starvation; metabolic derangements in diabetes mellitus and related disorders. d. Biological Oxidation: Electron Transport Chain (ETC), oxidative phosphorylation, and mechanisms of ATP synthesis; regulation and clinical implications of mitochondrial dysfunction and oxidative stress.	10 hours
III	**Lipid metabolism** a. Classification, functions, and properties of lipids and lipoproteins (HDL, LDL, VLDL, chylomicrons) b. β-oxidation and de-novo synthesis of fatty acids: Ketone bodies: synthesis, utilization, and clinical significance c. Biological significance of cholesterol, lipid profile, and its clinical significance d. Disorders associated with lipid metabolism: Hyperlipidaemias and hypercholesterolemia, lipid storage diseases, atherosclerosis, fatty liver disease, and obesity	7 hours
IV	**Amino acids and protein metabolism** a. Classification and Biological Functions: Classification and physiological roles of amino acids. Structure and functions of proteins and plasma proteins b. General Metabolism of Amino Acids: Transamination, oxidative and non-oxidative deamination, decarboxylation. Urea cycle – nitrogen disposal and detoxification. Fate of carbon skeletons of amino acids (glucogenic vs ketogenic). c. Catabolism of Specific Amino Acids and Related Disorders: Catabolism of phenylalanine and tyrosine and their metabolic disorders	10 hours

	(Phenylketonuria, Albinism, Alkaptonuria, Tyrosinemia) and Inborn errors of branched chain and aromatic amino acids d. Biochemical significance of neurotransmitters and hormones derived from amino acids: 5-HT (serotonin), melatonin, dopamine, noradrenaline, adrenaline e. Catabolism of heme and related disorders (jaundice).	
V	**Nucleic acid metabolism and genetic information transfer** a. Nucleotide Metabolism and their related disorders: Biosynthesis of purine and pyrimidine nucleotides. Catabolism of purine nucleotides (uric acid formation). Clinical significance of Hyperuricemia and Gout. b. Genome Structure and Central Dogma: Organization of the mammalian genome. Introduction to DNA replication, Transcription, and Translation. c. Genetic Code and Regulation of Protein Synthesis: Properties of the genetic code: Inhibitors of transcription and translation (antibiotics, toxins) d. DNA Repair and Related Disorders: DNA damage types, Repair mechanisms. Overview of clinical disorders associated with faulty DNA repair.	8 hours

Recommended References *(Preferably latest editions)*:

1. Nelson, D.L., Cox, M.M. and Hoskins, A., *Lehninger Principles of Biochemistry*. New York: W.H. Freeman.
2. Kennelly, P.J., Rodwell, V.W., Bender, D.A., Botham, K.M. and Weil, P.A., *Harper's Illustrated Biochemistry*. New York: McGraw-Hill Education.
3. Murray, R.K., Bender, D.A., Botham, K.M., Kennelly, P.J., Rodwell, V.W. and Weil, P.A., *Harper's Biochemistry*. New York: McGraw-Hill.
4. Voet, D. and Voet, J.G., *Biochemistry*. New York: John Wiley & Sons.
5. Devlin, T.M., *Textbook of Biochemistry with Clinical Correlations*. New York: Wiley-Liss.
6. Satyanarayana, U. and Chakrapani, U., *Biochemistry*. Kolkata: Books and Allied (P) Ltd.
7. Stryer, L., *Biochemistry*. New York: W.H. Freeman.

Course Code	Course Title			Course Type
BP203T	**Human Anatomy, Physiology and Pathophysiology II (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
4	4	--	--	60
Maximum Marks	SE			ESE
100	40			60

COURSE OBJECTIVES

The objectives of this course are to:

1. Understand the anatomy and physiology of major body systems.
2. Learn mechanisms of neurological, gastrointestinal, respiratory, renal, endocrine, and reproductive functions.
3. Identify common pathophysiological conditions affecting each organ system.
4. Correlate structural and functional abnormalities with disease symptoms.
5. Equip students with foundational knowledge for interpreting disease processes and planning rational pharmacotherapy.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Describe the structural organization of the nervous, gastrointestinal, respiratory, urinary, endocrine and reproductive systems.
2	Explain the physiological mechanisms that regulate the functions of nervous, endocrine and reproductive systems.
3	Illustrate the etiology and development of common diseases affecting different organ systems including cancer.
4	Analyze the pathophysiological alterations associated with disorders of the nervous, gastrointestinal, respiratory, renal and endocrine systems.
5	Interpret clinical manifestations and case findings related to organ system dysfunctions.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Nervous System** a) Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse and neurotransmitters. Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem and cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity). b) Pathophysiology of epilepsy, Parkinson's disease, stroke, migraine, depression, schizophrenia, Alzheimer's disease and meningitis.	14 hours
II	**Gastrointestinal System** a) Anatomy of GI tract with special reference to anatomy and functions of stomach (acid production in the stomach and its regulation through parasympathetic nervous system; role of pepsin in protein digestion). Anatomy and functions of small intestine and large intestine. Anatomy and functions of salivary glands, pancreas and liver. Movements of GIT, digestion and absorption of nutrients. b) Pathophysiology of inflammatory bowel diseases, peptic ulcer, jaundice, hepatitis, typhoid and alcoholic and non alcoholic fatty liver disease	12 hours
III	a) **Respiratory System** Anatomy of respiratory system with special reference to anatomy of lungs. Mechanism of respiration and regulation of respiration. Lung volumes and capacities, transport of respiratory gases, artificial respiration and resuscitation methods. b) Pathophysiology of asthma, chronic obstructive pulmonary diseases and tuberculosis. c) **Urinary System** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons. Functions of kidney and urinary tract. Physiology of urine formation, micturition reflex and role of kidneys in acid–base balance. Role of Renin Angitensin Aldosterone System in kidney. d) Pathophysiology of acute and chronic renal failure and urinary tract infections.	12 hours
IV	**Endocrine System** a) Classification of hormones and mechanism of hormone action. Structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland and thymus. b) Pathophysiology of diabetes, hypothyroidism, hyperthyroidism, goitre and polycystic ovary syndrome.	10 hours

V	**Reproductive System and Cancer** a) Anatomy of male and female reproductive system. Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition. b) Pathophysiology of sexually transmitted diseases: AIDS, syphilis and gonorrhea. c) Etiology and pathogenesis of cancer.	12 hours

Recommended References *(Preferably latest editions)*:

1. Wilson, K.J.W., *Ross and Wilson Anatomy and Physiology in Health and Illness*. Churchill Livingstone, New York.
2. Tortora, G.J. and Grabowski, S.R., *Principles of Anatomy and Physiology*. Palmetto, GA, U.S.A.
3. Guyton, A.C. and Hall, J.E., *Textbook of Medical Physiology*. Elsevier.
4. Chatterjee, C.C., *Human Physiology (Vol. I & II)*. Academic Publishers, Kolkata.
5. Mohan, H., *Textbook of Pathology*. Jaypee Publishers.
6. Porth, C.M., *Pathophysiology: Concepts of Altered Health States*. Lippincott Williams & Wilkins.
7. Kumar, V., Abbas, A.K., Aster, J.C. and Deyrup, A.T., *Robbins and Kumar Basic Pathology*. Elsevier.

Course Code	Course Title			Course Type
BP204T	**Pharmaceutical Organic Chemistry (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
4	4	--	--	60
Maximum Marks	SE			ESE
100	40			60

COURSE OBJECTIVES

The objectives of this course are to:

1. Develop a clear understanding of the chemistry of saturated hydrocarbons.
2. Study the chemistry and reactions of unsaturated hydrocarbons.
3. Understand the chemistry and reaction mechanisms of alkyl halides.
4. Explain the chemistry of aromatic hydrocarbons and their derivatives.
5. Provide an understanding of carbonyl compounds and fundamental organic reaction mechanisms relevant to pharmaceuticals.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Describe the chemical reactions and mechanisms of aliphatic saturated hydrocarbons.
2	Explain the reactions and mechanisms of aliphatic unsaturated hydrocarbons.
3	Understand nucleophilic substitution and elimination reactions of alkyl halides.
4	Explain electrophilic aromatic substitution reactions and the effect of substituents.
5	Apply knowledge of carbonyl compounds and reaction mechanisms in pharmaceutical chemistry.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Aliphatic Saturated Hydrocarbons –** **Alkanes** • Methods of preparation: Wurtz reaction, Kolbe's reaction, Clemmensen reduction, Wolff–Kishner reduction • Chemical reactions of alkanes • Mechanism of free radical substitution (halogenation) • Pharmaceutical applications of alkanes: Liquid paraffin, soft paraffin, hard paraffin **Cycloalkanes** • Baeyer's strain theory and its limitations • Coulson–Moffitt modification • Sachse–Mohr theory	12 hours
II	**Aliphatic Unsaturated Hydrocarbons – -** **Alkenes** • Methods of preparation: o Dehydration of alcohols o Dehydrohalogenation of alkyl halides o Dehalogenation of vicinal dihalides o Wittig reaction • Chemical reactions of alkenes • Mechanism of electrophilic addition reactions • Markovnikov's and anti-Markovnikov's rule • Ozonolysis **Conjugated Dienes** • Stability of conjugated dienes • Mechanism of Diels–Alder reaction Electrophilic and free radical addition reactions • 1,2- and 1,4-addition reactions	12 hours
III	**Alkyl Halides** • Nucleophilic substitution reactions: **SN1 and SN2** o Mechanism, kinetics, substrate structure, solvent effect, stereochemistry • Elimination reactions: **E1 and E2** o Mechanism, kinetics, substrate structure, solvent effect, stereochemistry • Zaitsev's (Saytzeff's) rule with examples • Comparison of substitution vs elimination reactions	12 hours

IV	**: Benzene and Its Derivatives – -** • IUPAC nomenclature of mono- and di-substituted benzene derivatives • Structure of benzene • Molecular orbital picture and resonance • Aromaticity and Hückel's rule • Electrophilic aromatic substitution reactions: ○ Nitration ○ Halogenation ○ Friedel–Crafts alkylation and its limitations ○ Friedel–Crafts acylation ○ Sulphonation and desulphonation • Effect of substituents on reactivity and orientation	12 hours
V	**Carbonyl Compounds -** **Aldehydes and Ketones** • Preparation and properties of carbonyl compounds • Nucleophilic addition reactions • Aldol condensation and crossed aldol condensation • Cannizzaro and crossed Cannizzaro reactions • Benzoin and Perkin condensation • Oxidation and reduction reactions • Pharmaceutical applications of carbonyl compounds: Chloral, Paraldehyde, Ketoprofen	12 hours

Recommended References *(Preferably latest editions)*:

1. Morrison, R.T., Boyd, R.N. and Bhattacharjee, S.K., *Organic Chemistry*. Pearson Education India.
2. Finar, I.L., *Organic Chemistry, Vol. I.* Pearson Books.
3. Bahl, B.S. and Bahl, A., *Textbook of Organic Chemistry*. S. Chand & Company.
4. Furniss, B.S., *Vogel's Textbook of Practical Organic Chemistry*.

Course Code	Course Title			Course Type
BP205T	**Pharmacognosy and Phytochemistry (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
4	4	--	--	60
Maximum Marks	SE			ESE
100	40			60

COURSE OBJECTIVES

The objectives of this course are to:

1. Understand major metabolic pathways and the biogenetic origin of primary and secondary phytoconstituents, including the use of modern tools for pathway studies.
2. Study and interpret the pharmacognostic features of crude drugs containing primary metabolites such as carbohydrates, proteins/enzymes, and lipids.
3. Study and interpret the pharmacognostic features of crude drugs containing secondary metabolites such as alkaloids, glycosides, tannins, resins, volatile oils, flavonoids, phenolics, and terpenoids.
4. Impart knowledge of conventional and modern extraction techniques and enable selection of appropriate extraction methods.
5. Develop competency in isolation, identification, characterization, and quality evaluation of medicinal plants and botanicals.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Describe biosynthetic pathways and genetic tools involved in phytoconstituent production.
2	Classify and explain drugs containing primary and secondary metabolites.
3	Apply traditional and modern extraction and isolation methods.
4	Explain qualitative and quantitative analysis of plant metabolites.
5	Evaluate identity, purity, and quality of herbal raw materials.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Metabolic Pathways and Biogenetic Studies –** Brief study of basic metabolic pathways and biosynthesis of secondary metabolites including: • Shikimic acid pathway • Acetate pathway • Amino acid pathways Utilization of radioactive isotopes in biogenetic studies. Introduction to pathway prediction tools and modern genetic tools such as **CRISPR/Cas9**.	10 hours
II	**Primary Metabolites –** **General classification and identification tests** **Pharmacognostic study** (biological source, distribution, identifying characters, chemical constituents, specific tests, therapeutic uses, and commercial applications) of: **Carbohydrates:** • Acacia, • Agar • Tragacanth • Honey **Proteins and Enzymes:** • Gelatin • Casein • Proteolytic enzymes: Papain, Bromelain, Serratiopeptidase, Urokinase, Streptokinase, Pepsin **Lipids (Waxes, Fats, Fixed Oils):** • Castor oil • Olive oil • Cocoa butter • Wool fat • Beeswax	12 hours
III	**Secondary Metabolites –** **General classification and identification tests** **Pharmacognostic study** (biological source, distribution, cultivation of underlined drugs, identifying characters, chemical constituents, specific tests, therapeutic uses, and commercial applications) of: **Alkaloids:** • Vinca • Rauwolfia	12 hours

	• Opium **Volatile Oils:** • Lemongrass • Clove • Cinnamon • Fennel **Tannins:** • Myrobalans • Catechu • Pomegranate **Resins:** • Guggul • Asafoetida **Glycosides:** • Senna • Liquorice • Digitalis **Phenylpropanoids and Flavonoids:** • Green Tea • Ginkgo • Flax seed **Iridoids, Other Terpenoids and Naphthoquinones:** • Gentian • Artemisia	
IV	**Extraction Methods for Medicinal Plants –** **Conventional Methods of Extraction:** • Infusion • Decoction • Digestion • Maceration • Percolation • Reflux • Distillation • Soxhlet extraction • Successive solvent extraction **Modern Methods of Extraction:** • Supercritical fluid extraction • Microwave-assisted extraction • Ultrasonic-assisted extraction • Enzyme-assisted extraction • Pressurized liquid extraction	12 hours
V	**Overview of Isolation, Identification and Characterization Techniques–**	14 hours

	Separation and Isolation Techniques: • Planar chromatography • Column chromatography • Preparative TLC • Flash chromatography **Identification Techniques:** • Phytochemical tests • Chromatographic techniques • Spectroscopic techniques Fingerprinting of medicinal plants using **TLC/HPTLC**. Types and significance of **markers (phytochemical reference standards)**. Screening and analysis of major metabolites: • Alkaloids • Glycosides • Saponins • Tannins • Resins • Flavonoids • Phenolics • Steroids	

Recommended References *(Preferably latest editions)*:

1. Dewick, P.M., *Medicinal Natural Products: A Biosynthetic Approach*. John Wiley & Sons.

2. Evans, W.C., *Trease and Evans' Pharmacognosy*. W.B. Saunders & Co., London.

3. Wagner, H., and Bladt, S., Plant Drug Analysis: A Thin Layer Chromatography Atlas. Springer-Verlag.

4. Harborne, J.B., Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. Chapman & Hall.

Course Code	Course Title			Course Type
BP206T	**Physical Pharmaceutics (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES

The objectives of this course are to:

1. Provide a comprehensive understanding of the theory and principles of pharmaceutical processes and unit operations involved in drug manufacturing.
2. Impart knowledge of physicochemical phenomena such as solubility, dissolution, interfacial phenomena, rheology, and micromeritics relevant to dosage form design.
3. Develop understanding of colloidal and coarse dispersions, including suspensions and emulsions, and their pharmaceutical applications.
4. Familiarize students with rheological and micromeritic properties of powders and dispersions and their role in formulation development and evaluation.
5. Build a strong foundation for formulation development, process optimization, and quality control of pharmaceutical dosage forms.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain and interpret the fundamental principles governing pharmaceutical manufacturing processes and unit operations.
2	Analyze physicochemical properties of drugs and excipients and correlate them with formulation stability, quality, and performance.
3	Apply concepts of interfacial phenomena, colloids, and dispersions in the design and evaluation of pharmaceutical dosage forms.
4	Evaluate and optimize pharmaceutical processes by controlling variables related to rheology, micromeritics, and dispersion systems.
5	Demonstrate foundational competency required for advanced studies in formulation development, industrial pharmacy, and pharmaceutical research.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Solubility distribution phenomenon & buffers** Solubility expression, Solute solvent interactions, Solubility of liquid and liquids, Solubility of solids and liquids, Solubility of Gas in Liquids, Raoult's Law. Factors affecting solubility, Measurement of saturation Solubility, Effect of pH on solubility, Partition Coefficient – Measurement and significance, Critical Solution Temperature and Applications. Introduction to buffers, Buffers in pharmaceutical and biological system, pH determination methos (Electrometry and colorimetry). Buffer equation / Factor influencing the pH of buffer solutions, Factor influencing Buffer capacity, General procedure for preparing buffers, Indicators.	9 hours
II	**Interfacial phenomenon** Liquid interface: Surface and interfacial tension, surface free energy, Measurement of surface and interfacial tension, Spreading coefficient, surface active agent, HLB, detergency, types of monolayers at liquid surface. Adsorption at solid interface, Liquid Interface (contact angle, activated charcoal and Wetting). Adsorption of surface-active agents. Electric properties of interface / Electric double layer, Nernst and zeta potential effect of electrolytes	8 hours
III	**Colloidal and Coarse Dispersion** Colloidal dispersions: Types of colloidal dispersions (Lyophobic, Lyophilic, Association colloids), Optical properties of colloids, Kinetic properties of colloids, Electrical properties of colloids, Size and shape of colloidal systems, Stability of colloidal system (peptization and protective action), Application of Colloidal System. Coarse Dispersions: Suspensions, stokes law (Theory of sedimentation), Effect of Brownian movement / Sedimentation of flocculated particles, sedimentation parameters. Flocculation and controlled structure flocculation. Theories of emulsification and stabilizaition (DLVO Theory, Monomolecular adsorption, Multimolecular adsorption, Film formation, Solid particle adsorption). Physical instabilities of emulsions (creaming, coalescence and breaking, and phase inversion).	12 hours
IV	**Rheological studies** Newtonian systems and non-Newtonian systems. Thixotropy – measurement / Bulges and spurs. Negative thixotropy, Determination of	8 hours

	rheological properties (Viscometers / single and multi-point). Viscoelasticity, psycho-rheology. Applications of rheology in pharm	
V	**Micromeritics** Particle size and size distribution, Particle Shape and Surface area: Methods for determination and significance. Flow properties of powders: determination, significance and methods of enhancement. Advanced flow properties of powers (Powder flow tester).	8 hours

Recommended References *(Preferably latest editions)*:

1. Sinko, P.J., *Martin's Physical Pharmacy and Pharmaceutical Sciences*.
2. Allen, L.V. and McPherson, T.B., *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*.
3. Adejare, A., *Remington: The Science and Practice of Pharmacy*.
4. Aulton, M.E. and Taylor, K.M.G., *Aulton Pharmaceutics: The Design and Manufacture of Medicines*. Elsevier.
5. Lachman, L. and Libbermann, H.A., *The Theory and Practice of Industrial Pharmacy*.
6. Mendham, J., Denney, R.C., Barnes, J.D. and Thomas, M.J.K., *Vogel's Textbook of Quantitative Chemical Analysis*.

Myers, D., *Surfaces, Interfaces, and Colloids: Principles and Applications*.

Ladisch, M.R., *Rheology of Fluid and Semisolid Foods*. Springer.

Course Code	Course Title			Course Type
BP207P	**Biochemistry (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES

The objectives of this course are:

1. To develop skills to identify and differentiate carbohydrates and proteins through classical qualitative biochemical tests.
2. To apply biochemical techniques for analysis of pathological conditions using urine and blood samples.
3. To perform estimations of clinically important biomolecules such as glucose, cholesterol, urea, creatinine, uric acid, and proteins in biological fluids.
4. To demonstrate enzymatic activity and study factors affecting enzyme function, including substrate concentration and temperature.
5. To interpret biochemical results and correlate them with clinical conditions such as diabetes, renal dysfunction, and lipid disorders.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Identify proteins and carbohydrates using qualitative biochemical tests and explain their physiological relevance.
2	Detect normal and abnormal constituents in urine and interpret their diagnostic significance.
3	Estimate and interpret levels of glucose, cholesterol, urea, creatinine, uric acid, and serum proteins, and correlate results with clinical conditions.
4	Demonstrate enzyme–substrate reactions and evaluate the effect of temperature and substrate concentration on enzymatic activity.
5	Analyze, record, and report biochemical results accurately and relate practical findings to theoretical knowledge and clinical application.

Detailed Syllabus:

List of practical
(Minimum 12experiments must be performed) 1. Identification tests for proteins (Albumin and Casein). 2. Qualitative analysis of carbohydrates* (Glucose, Fructose, Lactose, Sucrose, and Starch). 3. Qualitative analysis of urine for normal and abnormal constituents. 4. Estimation of blood glucose. 5. Estimation of total cholesterol and HDL cholesterol. 6. Estimation of urea, creatinine, and uric acid in serum. 7. Estimation of serum total protein and albumin. 8. Study of enzymatic hydrolysis of starch. 9. Study of the effect of temperature on salivary amylase activity. 10. Study of the effect of substrate concentration on salivary amylase activity. 11. Estimation of hemoglobin in blood by Sahli's method / Cyanmethemoglobin method. 12. Estimation of serum bilirubin (total and direct bilirubin). 13. Estimation of glycogen content 14. Estimation of SGOT and SGPT
Recommended References *(Preferably latest editions)*: 1. Plummer, D. T. *An Introduction to Practical Biochemistry.* McGraw-Hill, New York. 2. Wilson, K., and Walker, J. *Principles and Techniques of Biochemistry and Molecular Biology.* Cambridge University Press. 3. Varley, H., Gowenlock, A. H., Bell, M., and Bell, J. L. *Varley's Practical Clinical Biochemistry.* Heinemann Medical Books. 4. Burtis, C. A., Ashwood, E. R., and Bruns, D. E. *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics.* Elsevier. 5. Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., and Weil, P. A. *Harper's Illustrated Biochemistry.* McGraw-Hill. 6. Freifelder, D. *Essential Molecular Biology: A Practical Approach.* Oxford University Press.

Course Code	Course Title			Course Type
BP208P	**Human Anatomy, Physiology and Pathophysiology II (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES

The objectives of this course are to:

1. Provide foundational knowledge of the structure and functions of major organ systems of the human body.
2. Develop understanding of physiological mechanisms responsible for maintenance of homeostasis.
3. Explain the pathophysiology of diseases affecting different organ systems.
4. Explore causes of diseases and the body's responses to pathological conditions.
5. Build a strong base for clinical learning through the study of functional and structural changes in disease states.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the gross morphology, structures, and functions of various organs and organ systems of the human body.
2	Demonstrate basic emergency response procedures such as cardiopulmonary resuscitation (CPR).
3	Describe the etiology and pathogenesis of selected disease states.
4	Identify signs and symptoms, risk factors, diagnostic methods, prevention, treatment strategies, and complications of diseases.
5	Understand coordinated working patterns of different organs of each system and perform experiments related to special senses and nervous system.

Detailed Syllabus:

List of practical
(Minimum of 12 experiments must be performed) Practical HAPP allows the verification of physiological processes discussed in theory classes through experiments on living tissues, simulated videos, models, and charts. 1. Study of nervous system using specimens and models. 2. Study of respiratory system using models. 3. Study of gastrointestinal system using models. 4. Study of reproductive system using models. 5. Demonstration of general neurological examination. 6. Demonstration of function of olfactory nerve. 7. Examination of different types of taste. 8. Demonstration of visual acuity. 9. Demonstration of reflex activity. 10. Recording of body temperature. 11. Determination of tidal volume and vital capacity. 12. Recording of body mass index (BMI). 13. Study of family planning devices and pregnancy diagnosis tests. 14. Understanding pathophysiology of IBD, peptic ulcer, jaundice, hepatitis, typhoid, asthma, tuberculosis, diabetes, and thyroid disorders through case files / case reports. 15. Hands-on training in cardiopulmonary resuscitation (CPR).
Recommended References *(Preferably latest editions)*: 1. Wilson, K. J. W., and Waugh, A. *Anatomy and Physiology in Health and Illness.* Churchill Livingstone, New York. 2. Best, C. H., and Taylor, N. B. *The Physiological Basis of Medical Practice.* Williams & Wilkins, Baltimore. 3. Guyton, A. C., and Hall, J. E. *Textbook of Medical Physiology.* Elsevier / W.B. Saunders, Philadelphia. 4. Tortora, G. J., and Grabowski, S. R. *Principles of Anatomy and Physiology.* John Wiley & Sons. 5. Brunton, L., Chabner, B., and Knollmann, B. *Goodman & Gilman's The Pharmacological Basis of Therapeutics.* McGraw-Hill, New York. 6. Colledge, N. R., Walker, B. R., and Ralston, S. H. *Davidson's Principles and Practice of Medicine.* Churchill Livingstone, London.

Course Code	Course Title			Course Type
BP209P	**Pharmaceutical Organic Chemistry (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES

The objectives of this course are to:

1. Understand and follow essential laboratory safety protocols for handling chemicals, glassware, and equipment.
2. Identify and analyze organic compounds through their physical properties and functional group reactivity.
3. Apply ball-and-stick molecular models to visualize and interpret the structure of organic compounds.
4. Perform purification techniques such as crystallization to isolate and refine organic substances.
5. Synthesize simple organic compounds and their derivatives using standard laboratory methods.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Recall and outline the preliminary qualitative tests used for identifying water-insoluble and immiscible organic compounds.
2	Understand the synthesis methods for preparing simple organic compounds and their derivatives.
3	Apply crystallization techniques to purify organic compounds effectively.
4	Analyze experimentally to detect elements and functional groups to identify unknown organic compounds.
5	Interpret and analyze organic compounds through systematic qualitative analysis to confirm their chemical nature.

Detailed Syllabus:

List of practical
(Minimum 12 experiments to be performed) 1. **Systematic qualitative analysis of minimum of five water-insoluble or water-immiscible unknown organic compounds from different chemical classes:** a. Preliminary tests: Color, odour, Solubility tests, test for aromaticity, test for saturation/unsaturation etc. b. Detection of elements such as nitrogen, sulphur and halogens by Lassaigne's test c. Determination of Functional group tests such as phenols, amides, amines, carboxylic acids, aldehydes and ketones, alcohols, esters, aromatic and halogenated hydrocarbons and nitro compounds. d. Preparation of the derivatives and confirmation of the unknown organic compound by melting point / boiling point. 2. **Building Molecular Models:** Students will use ball-and-stick models to create structures of molecules and understand their shapes and bonding. 3. **Crystallization Method** Students will learn how to purify three organic compounds using the crystallization technique.
Recommended References *(Preferably latest editions)*: 1. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A. R. *Vogel's Textbook of Practical Organic Chemistry.* Longman Scientific & Technical, London. 2. Mann, F. G. and Saunders, B. C. *Practical Organic Chemistry.* Pearson Education. 3. Shriner, R. L., Hermann, C. K. F., Morrill, T. C., Curtin, D. Y. and Fuson, R. C. *The Systematic Identification of Organic Compounds.* John Wiley & Sons. 4. Vogel, A. I. *Elementary Practical Organic Chemistry.* Longman Group Ltd. 5. Pavia, D. L., Lampman, G. M., Kriz, G. S. and Engel, R. *Introduction to Organic Laboratory Techniques.* Cengage Learning.

Course Code	Course Title			Course Type
BP210P	**Pharmacognosy and Phytochemistry (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES

The objectives of this course are to:

1. Perform chemical tests for the identification of gums, resins, oils, fats, waxes, and unorganized drugs.
2. Examine crude drugs using transverse section and powder microscopy for correct identification.
3. Apply suitable extraction techniques and study their effect on yield of crude extracts.
4. Isolate and identify important phytoconstituents and volatile oils using standard procedures.
5. Evaluate herbal raw materials collected from field/market sources as per Pharmacopoeial standards.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Identify unorganized crude drugs using specific chemical tests.
2	Analyze organized crude drugs through microscopy and powder analysis.
3	Select and perform appropriate extraction methods for herbal drugs.
4	Isolate and characterize phytoconstituents using laboratory techniques and TLC.
5	Assess and compare the quality and purity of herbal raw materials with official standards.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. Chemical tests for identification of Agar, Acacia, Tragacanth, Honey. 2. Chemical tests for identification of Castor oil, Olive oil, Wool fat, Beeswax. 3. Chemical tests for identification of Asafoetida, Catechu, Aloe. 4. Transverse section and powder microscopy of a vinca leaf. 5. Transverse section and powder microscopy of a cinnamon bark. 6. Transverse section and powder microscopy of a fennel fruit. 7. Transverse section and powder microscopy of a clove flower bud. 8. Transverse section and powder microscopy of a Tulsi stem. 9. Transverse section and powder microscopy of a Liquorice roots. 10. Study of effect on different extraction techniques on yield of crude extract (maceration, decoction, soxhlation). 11. Isolation of volatile oil and it's TLC. 12. Isolation of caffeine from tea. 13. Isolation of Hesperidin from lemon peel. 14. Isolation of Glycyrhizin from liquorice roots. 15. Isolation of Pectin from orange peel. 16. Experiential learning based experiment involving evaluation and comparison of field/market collected herbal raw materials with Pharmacopoeial standards.
Recommended References *(Preferably latest editions)*: 1. Trease, G. E. and Evans, W. C. *Pharmacognosy.* Elsevier. 2. Harborne, J. B. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.* Springer. 3. Wallis, T. E. *Textbook of Pharmacognosy.* CBS Publishers & Distributors, New Delhi. 4. Tyler, V. E., Brady, L. R. and Robbers, J. E. *Pharmacognosy.* Lea & Febiger.

Course Code	Course Title			Course Type
BP211P	**Physical Pharmaceutics (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES

The objectives of this course are to:

1. Introduce basic laboratory techniques for determining physicochemical properties such as surface tension, viscosity, and density in pharmaceutical systems.
2. Develop understanding of interfacial phenomena and surfactant behavior, including micelles, critical micellar concentration (CMC), and HLB in formulation design.
3. Train students in evaluating disperse systems through sedimentation studies and the effect of suspending agents.
4. Provide practical experience in powder characterization, including particle size distribution, density, flow properties, porosity, and the role of glidants.
5. Develop skills in determining solubility, partition coefficient, buffer capacity, and related equilibria relevant to drug formulation.

Course Outcomes (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Demonstrate practical knowledge of principles and procedures involved in measuring surface tension, viscosity, density, and related physical properties using standard laboratory apparatus.
2	Determine and interpret surfactant-related parameters such as CMC and HLB and explain their significance in formulation stability and performance.
3	Conduct experiments and analyze results related to sedimentation volume and evaluate the influence of type and concentration of suspending agents on dispersion stability.
4	Evaluate micromeritic and flow properties of powders by determining particle size distribution, bulk density, tapped density, Hausner ratio, Carr's index, angle of repose, true density, and porosity, and interpret the effect of glidants.
5	Perform and assess experiments on solubility, partition coefficient, critical solution temperature, adsorption studies, and buffer capacity, and apply findings to formulation decisions.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. Determination of surface tension of given liquids by drop count method and drop weight method. 2. Determination of critical micellar concentration (CMC) of surfactants. 3. Determination of viscosity of liquids using Ostwald's viscometer and Brookfield viscometer. 4. Determination of HLB value of a surfactant. 5. Calculation of isotonicity by different methods (Sodium Chloride Equivalent Method). 6. Determination of particle size and particle size distribution using sieving method. 7. Determination of particle size and particle size distribution using microscopic method. 8. Determination of densities and derived properties of powders (bulk density, tapped density, Hausner ratio, Carr's compressibility index), true density, and porosity. 9. Determination of angle of repose and influence of glidants on angle of repose. 10. Determination of solubility of a drug at different pH/buffer systems at room temperature. 11. Determination of partition coefficient of a drug in n-octanol and water system. 12. Determination of partition coefficient of a drug in benzene and water system. 13. Determination of critical solution temperature and composition of phenol–water system. 14. Determination of specific surface area of charcoal by adsorption of acetic acid on activated charcoal. 15. Determination of buffer capacity at various stages of titration of a weak acid against a strong base and determination of pKa. ***Note:*** Compare the values of various physicochemical properties with marketed formulations wherever possible.
Recommended References *(Preferably latest editions)*:' 1. Sinko, P. J. *Martin's Physical Pharmacy and Pharmaceutical Sciences.* Lippincott Williams & Wilkins. 2. Aulton, M. E. and Taylor, K. M. G. *Aulton's Pharmaceutics: The Design and Manufacture of Medicines.* Elsevier. 3. Lachman, L., Lieberman, H. A. and Kanig, J. L. *The Theory and Practice of Industrial Pharmacy.* CBS Publishers & Distributors. 4. Allen, L. V., Popovich, N. G. and Ansel, H. C. *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems.* Lippincott Williams & Wilkins. 5. Cooper, S. J. and Gunn, C. *Cooper and Gunn's Tutorial Pharmacy.* CBS Publishers & Distributors.

Course Code*	Course Title*			Course Type
BP212P SEC1	Communication Skills			Elective
BP212P SEC2	Mental Well-Being, Stress & Conflict Management			
BP212P SEC3	Fundamentals of Computer Operations			
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	2	30
Maximum Marks	SE	ESE		
50	20	30		

* Only 1 elective course shall be selected

The syllabi for elective subjects are given in the *appendix*