



SHREE SAI PRAKASHAN

B.Pharm NEP 2020 Syllabus

Complete 4-year, 8-semester PCI curriculum (2026-27 onward)

The Bachelor of Pharmacy (B.Pharm) is a four-year, eight-semester degree. PCI has mandated a revised NEP 2020-aligned syllabus for all approved institutions from the 2026-27 session. Alongside the classical pharmacy subjects, it introduces computing, data science and AI throughout the programme — Python, machine learning, data analytics and AI applications are now core courses.

4

years

8

semesters

49

subjects

249

units

First Year books are published and available now.

All six BP101T-BP106T titles, written to this syllabus - <https://www.shreeshikshashreesai.com/pharmacy/b-pharma/>

Contents

This document sets out the complete PCI B.Pharm syllabus under NEP 2020. It opens with a semester-by-semester course overview, then gives every subject in full: teaching hours, the topics it covers, and a unit-by-unit breakdown with the hours allotted to each unit.

COURSE OVERVIEW

First Year

Semester I		6 subjects
BP101T	Basics of Python Programming for Pharmaceutical Sciences	NEW 30 h
BP102T	General Pharmacy	45 h
BP103T	Healthcare Psychology and Communication Skills	NEW 15 h
BP104T	Human Anatomy, Physiology and Pathophysiology I	60 h
BP105T	Introduction to Pharmacognosy	45 h
BP106T	Pharmaceutical Inorganic and Analytical Chemistry	45 h
Semester II		6 subjects
BP201T	Applied Biostatistics and Data Analytics for Pharmaceutical Sciences	NEW 30 h
BP202T	Biochemistry	45 h
BP203T	Human Anatomy, Physiology and Pathophysiology II	60 h
BP204T	Pharmaceutical Organic Chemistry	60 h
BP205T	Pharmacognosy and Phytochemistry	60 h
BP206T	Physical Pharmaceutics	45 h

Second Year

Semester III		8 subjects
BP301T	Introduction to Machine Learning in Pharmaceutical Sciences	NEW 30 h
BP302T	Environmental Sciences	15 h
BP303T	Ethics and Universal Human Values	15 h
BP304T	General Pharmacology	45 h
BP305T	Heterocyclic Compounds and Stereochemistry	45 h
BP306T	Pharmaceutical Dosage Forms I	45 h
BP307T	Pharmaceutical Engineering	45 h
BP308T	Pharmaceutical Microbiology	45 h
Semester IV		5 subjects
BP401T	Herbal Drug Technology	45 h
BP402T	Medicinal Chemistry	45 h
BP403T	Pharmaceutical Biotechnology	45 h
BP404T	Social Pharmacy and Public Health	30 h
BP405T	Systemic Pharmacology I	45 h

Third Year

Semester V		6 subjects
BP501T	Biomedical Chemistry	45 h
BP502T	Industrial Pharmacognosy	45 h
BP503T	Innovation and Startup Ecosystem	NEW 30 h
BP504T	Pharmaceutical Dosage Form II	30 h
BP505T	Pharmaceutical Quality Assurance	45 h
BP506T	Systemic Pharmacology II	45 h
Semester VI		6 subjects
BP601T	Advanced Pharmacognosy	45 h
BP602T	Biopharmaceutics and Pharmacokinetics	45 h
BP603T	Intellectual Property Rights	30 h
BP604T	AI Applications in Pharmaceutical Sciences	NEW 30 h
BP605T	Pharmaceutical Analysis	45 h
BP606T	Pharmaceutical Jurisprudence	45 h

Fourth Year

Semester VII

7 subjects

BP701T	Biostatistics & Research Methodology	45 h
BP702T	Cosmetics and Cosmeceuticals	30 h
BP703T	AI in Clinical Applications	NEW 30 h
BP704T	Modern Analytical Techniques	45 h
BP705T	Pharmacovigilance	45 h
BP706T	Pharmacy Practice	45 h
BP707T	Regulatory Affairs	30 h

Semester VIII

5 subjects

BP801T	Ethical Considerations and Translational Applications of AI in Pharmacy	NEW 30 h
BP802T	Clinical Pharmacotherapeutics	30 h
BP803T	Industrial Pharmacy and Facility Design	45 h
BP804T	Pharmaceutical Management	30 h
BP805T	Sterile Dosage Forms and Novel Drug Delivery System	45 h

FIRST YEAR

SEMESTER I

BP101T Basics of Python Programming for Pharmaceutical Sciences

30 hours · NEW in NEP 2020

Python fundamentals — data types, control structures, functions and libraries such as NumPy and Pandas; handling and visualising pharmaceutical and biological data; computational thinking for pharmacy applications.

Unit 1	Introduction to Python Programming	6 h
	Installing Python and an IDE (Jupyter Notebook, PyCharm, VS Code) and the advantages of IDEs over text editors; variables and data types (integers, floats, strings, booleans), type casting and operators (arithmetic, comparison, logical); input and output operations; basic string operations; and installing and using standard and third-party libraries.	
Unit 2	Control Structures & Functions	6 h
	Conditional statements (if, if-else, if-elif-else and nested conditions); loops (for and while) with break and continue; defining and calling functions, passing arguments and returning values; and writing modular programs for simple pharmaceutical tasks such as dosage and BMI calculation.	
Unit 3	Data Structures & File Handling	6 h
	Lists, tuples and dictionaries with indexing and slicing; string-manipulation techniques; an introduction to NumPy arrays (creation and arithmetic operations); reading and writing CSV files; and importing and manipulating small, structured healthcare datasets.	
Unit 4	Data Handling with Pandas	6 h
	The Pandas library — Series and DataFrame structures; reading CSV and Excel files such as PK-study datasets and ADR reports; inspecting data with head(), tail(), info() and describe(); cleaning data and handling missing values; and filtering, selecting, grouping and aggregating data.	
Unit 5	Data Visualization with Matplotlib	6 h
	Creating line plots, histograms, scatter plots and box plots with labelled axes, titles and legends; and visualising pharmaceutical datasets — concentration—time curves for oral and IV administration, ADR reporting rates, and dissolution profiles — with scientific interpretation of the plots.	

BP102T General Pharmacy

45 hours

Scope and history of the pharmacy profession; roles and responsibilities of a pharmacist; introduction to dosage forms, prescriptions and dispensing; pharmaceutical terminology and calculations.

Unit 1	Introduction to the Profession of Pharmacy	9 h
	History and evolution of the pharmacy profession in India (education, industry and organizations); the scope of pharmacy across community, hospital, clinical and industrial practice; pharmacopoeias (IP, BP, USP, BPC, the International Pharmacopoeia and the National Formulary of India) and the structure of the Indian Pharmacopoeia; and the structure, handling and Latin terminology of prescriptions.	
Unit 2	Pharmaceutical Calculations & Dosage Forms	9 h
	The metric system and calculations based on alligation, proof spirit, isotonic and dilute solutions and geometric dilution; posology and dose calculation by age, body weight and body surface area; routes of administration and the classification of dosage forms; and active pharmaceutical ingredients and excipients.	
Unit 3	Solid Dosage Forms	9 h
	Powders — classification, dusting, effervescent, efflorescent, hygroscopic powders and eutectic mixtures; tablets — definition, types, excipients and methods of preparation; and capsules — types, sizes, advantages and preparation.	
Unit 4	Monophasic & Biphasic Liquids	9 h
	Liquids for internal use (aromatic waters, syrups, elixirs, linctuses) and external use (liniments, lotions, gargles, mouthwashes, drops, tinctures); and biphasic systems — suspensions (flocculated and deflocculated) and emulsions, their types, emulsifying agents and preparation.	
Unit 5	Semisolid Dosage Forms	9 h
	Ointments, pastes, creams and gels — ointment bases and excipients and general methods of preparation; and suppositories and pessaries — types, ideal base properties, displacement value and preparation.	

BP103T Healthcare Psychology and Communication Skills

15 hours · NEW in NEP 2020

Basics of psychology in healthcare; patient behaviour and counselling; verbal and non-verbal communication; empathy, ethics and professional interaction with patients and healthcare teams.

Unit 1	Introduction to Psychology in Healthcare Definition, scope and relevance of psychology in the health sciences; branches with healthcare relevance (clinical, health, behavioural and developmental); sensation, perception and attention in clinical assessment; learning and memory in health-behaviour change; and emotion and motivation in health contexts.	3 h
Unit 2	Developmental & Behavioural Psychology Human developmental stages and their healthcare needs; personality theories and patient-interaction styles; psychological factors affecting illness perception and recovery; common psychological disorders (anxiety, depression, somatization); and coping strategies, resilience and stress management.	3 h
Unit 3	Foundations of Health Communication Elements and models of communication in healthcare; types of communication (interpersonal, group, mass and telehealth); barriers to effective clinical communication; active listening, questioning techniques and empathy; and culturally appropriate, inclusive communication.	3 h
Unit 4	Professional Communication in Healthcare Settings Communicating with patients, caregivers and interdisciplinary teams; delivering difficult news and handling emotionally charged situations; legal and ethical issues (confidentiality, consent); writing patient records, reports and discharge summaries; and digital communication tools in healthcare.	3 h
Unit 5	Health Psychology & Behavioural Interventions Health-belief models and illness behaviour; psychosomatic illness and the mind—body connection; behaviour-change theories (CBT, transtheoretical model) in treatment adherence; psychological first aid and crisis communication; and mental-health promotion and stigma reduction.	3 h

BP104T Human Anatomy, Physiology and Pathophysiology I

60 hours

Structure and function of the human body — cell, tissues and the skeletal, muscular, nervous and cardiovascular systems; introduction to the pathophysiology of common disorders.

Unit 1	Introduction to the Human Body, Cells & Tissues The scope of anatomy, physiology and pathophysiology; levels of structural organization, homeostasis and anatomical terminology; the structure and functions of the cell, transport across the membrane, cell division and cell signalling; the classification of tissues; and the basic principles of cell injury, adaptation (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia) and cell death.	12 h
Unit 2	Integumentary, Skeletal & Muscular Systems Structure and functions of skin and wound healing, with psoriasis, dermatitis and leprosy; the skeletal system — bones of the axial and appendicular skeleton, joints, muscle contraction and the neuromuscular junction; and the pathophysiology of rheumatoid arthritis, osteoporosis and gout.	12 h
Unit 3	Blood, Lymphatic System & Inflammation Body fluids and blood — composition, haemopoiesis, coagulation, blood grouping and transfusion; the lymphatic system; the basic mechanism of inflammation and repair; and haematological diseases — iron-deficiency and megaloblastic anaemia, sickle-cell anaemia, thalassaemia and haemophilia.	12 h
Unit 4	Peripheral Nervous System & Special Senses The peripheral nervous system — sympathetic and parasympathetic divisions and the spinal and cranial nerves; and the structure and functions of the eye, ear, nose and tongue, with the pathophysiology of glaucoma, cataract, myopia, otitis, vertigo and anosmia.	12 h
Unit 5	Cardiovascular System Anatomy of the heart and blood vessels, the conduction system, cardiac cycle and cardiac output, and the regulation of blood pressure and pulse; and the pathophysiology of hypertension, cardiac arrhythmias, congestive heart failure and ischaemic heart disease (angina, myocardial infarction, atherosclerosis).	12 h

BP105T Introduction to Pharmacognosy

45 hours

Definition, history and scope of pharmacognosy; classification of crude drugs; sources and cultivation of medicinal plants; introduction to primary and secondary plant metabolites.

Unit 1	Fundamentals of Pharmacognosy	10 h
	Definition, history, scope and development of pharmacognosy; sources of drugs (plant, animal, microbial, marine, mineral and tissue culture); milestones in drug discovery (morphine, quinine, aspirin, penicillin, taxol, artemisinin); herbal pharmacopoeias; and the classification of crude drugs (alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomic).	
Unit 2	Cultivation, Collection, Processing & Storage	8 h
	Methods of cultivation and Good Agricultural and Collection Practices (WHO / GAP / GCP); factors influencing cultivation, collection and storage; plant hormones, polyploidy, mutation and hybridization; and ex-situ and in-situ conservation and eco-pharmacognosy for endangered medicinal plants.	
Unit 3	Quality Control of Drugs of Natural Origin	8 h
	Adulteration and the evaluation of crude drugs by organoleptic, microscopic, physical, chemical and biological methods; physicochemical parameters (extractive values, moisture, ash values, bitterness, foaming and swelling index, optical rotation, acid and saponification value); and DNA barcoding.	
Unit 4	Plant Metabolites & Traditional Systems of Medicine	12 h
	Primary and secondary plant metabolites — carbohydrates, proteins, lipids, alkaloids, glycosides, flavonoids, tannins, terpenoids, volatile oils and resins; and the basic principles, dosage forms and role of the AYUSH and TCM traditional systems of medicine.	
Unit 5	Phyto-therapeutic Agents	7 h
	Biological source, constituents and uses of major herbal drug classes — adaptogens (Ashwagandha, Tulsi), hepatoprotectives (Milk thistle, Kutki), cardiovascular drugs (Garlic, Arjuna), antidiabetics (Gymnema, Fenugreek), anti-inflammatories (Turmeric, Boswellia), and CNS, antimicrobial and other agents.	

BP106T Pharmaceutical Inorganic and Analytical Chemistry

45 hours

Inorganic pharmaceuticals and their uses; limit tests; acids, bases and buffers; fundamentals of qualitative and quantitative (titrimetric) analysis.

Unit 1	Pharmaceutical Analysis, Errors & Impurities	7 h
	Techniques of analysis and methods of expressing the strength of solutions; primary and secondary standards; sources and types of errors and their minimization, accuracy, precision and significant figures; and impurities in pharmaceuticals with limit tests for chloride, sulphate, iron, arsenic, lead and heavy metals.	
Unit 2	Acid—Base Chemistry, Buffers & Electrolytes	8 h
	Acids, bases and buffers, the pH scale and buffer equation; isotonicity in IV fluids and ophthalmic solutions; major physiological electrolytes and replacement therapy (sodium chloride, potassium chloride, ORS); and acid—base titrations with the preparation and standardization of titrants.	
Unit 3	Non-aqueous, Precipitation & Complexometric Titrations	14 h
	Non-aqueous titrations and the estimation of weakly acidic and basic substances; precipitation titrations and gravimetry (Mohr's, Volhard's and Fajans methods); and complexometric titrations with metal-ion indicators and the standardization of disodium EDTA.	
Unit 4	Redox Titrations, GI Agents & Radiopharmaceuticals	10 h
	Redox titrations (permanganometry, cerimetry, iodimetry, iodometry); gastrointestinal agents — acidifiers, antacids and antimicrobials; and radiopharmaceuticals — radioactivity, applications of radioisotopes (I-131, Tc-99m, Co-60, P-32) and their safe handling.	
Unit 5	Miscellaneous Inorganic Compounds	6 h
	Expectorants (potassium iodide, ammonium chloride), emetics, haematinics (ferrous sulphate, ferrous gluconate), and poisons and antidotes.	

SEMESTER II

BP201T Applied Biostatistics and Data Analytics for Pharmaceutical Sciences

65 hours · NEW in NEP 2020

Descriptive and inferential statistics; probability distributions; hypothesis testing; correlation and regression; data-analytics workflows applied to pharmaceutical and clinical data.

Unit 1	Descriptive Statistics	6 h
	Types of data in pharmaceutical sciences (nominal, ordinal, interval, ratio) and sources of data (clinical trials, pharmacovigilance, quality control, PK studies); measures of central tendency and dispersion and their interpretation; skewness and distribution shape in biological measurements; and descriptive analysis using Python	

(NumPy, Pandas).

Unit 2	Probability & Statistical Distributions in Healthcare	6 h
	Basic probability concepts and laws, conditional probability and Bayes' theorem in clinical decision-making; random variables; the normal distribution in biological measurement; the binomial distribution in clinical-trial outcomes; the Poisson distribution for rare events such as adverse drug reactions; and visualising distributions in Python.	
Unit 3	Sampling & Statistical Inference	6 h
	Population versus sample and sampling techniques, sampling error and bias; the Central Limit Theorem; confidence intervals; the hypothesis-testing framework (null and alternative hypotheses); Type I and Type II errors, p-values and statistical significance — calculated and interpreted in Python.	
Unit 4	Correlation & Regression	6 h
	Correlation and the Pearson coefficient, interpreting positive and negative correlations; scatter plots and trend visualisation with dose—response data; simple linear regression and interpretation of regression coefficients; and the odds ratio in clinical risk analysis.	
Unit 5	Statistical Analysis Using Python — Case-based Learning	6 h
	Demonstration of descriptive statistics, correlation and linear regression on pharmaceutical datasets using Python libraries (SciPy, Statsmodels, Scikit-learn); interpretation of output summaries and p-values; and preparation of statistical reports.	

BP202T Biochemistry

45 hours

Structure and function of biomolecules — carbohydrates, lipids, proteins and nucleic acids; enzymes; bioenergetics and metabolism including glycolysis and the TCA cycle.

Unit 1	Enzymology	10 h
	Properties, nomenclature and IUB classification of enzymes and coenzymes; enzyme kinetics (Michaelis—Menten and Lineweaver—Burk plots); enzyme inhibitors and regulation (induction, repression, allosteric); therapeutic and diagnostic applications of enzymes and isoenzymes; vitamins and minerals; and clinical chemistry — liver and renal function tests.	
Unit 2	Bioenergetics & Carbohydrate Metabolism	10 h
	Introduction to biomolecules; bioenergetics and energy-rich compounds (ATP, GTP); carbohydrate metabolism — glycolysis, the citric-acid (TCA) cycle, gluconeogenesis, the HMP shunt and glycogen metabolism, blood-glucose regulation and derangements in diabetes mellitus; and biological oxidation — the electron transport chain and oxidative phosphorylation.	
Unit 3	Lipid Metabolism	7 h
	Classification and functions of lipids and lipoproteins (HDL, LDL, VLDL, chylomicrons); β -oxidation and de-novo synthesis of fatty acids and ketone bodies; cholesterol and the lipid profile; and disorders — hyperlipidaemia, atherosclerosis, fatty-liver disease and obesity.	
Unit 4	Amino Acid & Protein Metabolism	10 h
	Classification and functions of amino acids and proteins; transamination, deamination, decarboxylation and the urea cycle; catabolism of phenylalanine and tyrosine and related disorders (phenylketonuria, albinism, alkaptonuria); neurotransmitters and hormones derived from amino acids; and heme catabolism and jaundice.	
Unit 5	Nucleic Acid Metabolism & Genetic Information	8 h
	Biosynthesis and catabolism of purine and pyrimidine nucleotides, hyperuricaemia and gout; genome organization and the central dogma — DNA replication, transcription and translation; the genetic code and inhibitors of transcription and translation; and DNA damage and repair.	

BP203T Human Anatomy, Physiology and Pathophysiology II

60 hours

The respiratory, digestive, urinary, endocrine and reproductive systems and their functions; pathophysiology of related disorders.

Unit 1	Nervous System	14 h
	Organization of the nervous system, neurons and neuroglia, nerve conduction, action potential, synapses and neurotransmitters; the central nervous system — meninges, ventricles, cerebrospinal fluid, brain and spinal cord; and the pathophysiology of epilepsy, Parkinson's disease, stroke, migraine, depression, schizophrenia, Alzheimer's disease and meningitis.	

Unit 2	Gastrointestinal System	12 h
	Anatomy and functions of the GI tract, stomach acid production and regulation, small and large intestine, salivary glands, pancreas and liver, and digestion and absorption; and the pathophysiology of inflammatory bowel disease, peptic ulcer, jaundice, hepatitis, typhoid and fatty-liver disease.	
Unit 3	Respiratory & Urinary Systems	12 h
	The respiratory system — anatomy of the lungs, mechanism and regulation of respiration, lung volumes and gas transport, with the pathophysiology of asthma, COPD and tuberculosis; and the urinary system — kidney and nephron anatomy, urine formation, the renin—angiotensin—aldosterone system, and renal failure and urinary-tract infections.	
Unit 4	Endocrine System	10 h
	Classification of hormones and the mechanism of hormone action; the structure and functions of the pituitary, thyroid, parathyroid, adrenal, pancreas, pineal and thymus glands; and the pathophysiology of diabetes, hypothyroidism, hyperthyroidism, goitre and polycystic ovary syndrome.	
Unit 5	Reproductive System & Cancer	12 h
	Anatomy and functions of the male and female reproductive systems, sex hormones, menstruation, fertilization, spermatogenesis, oogenesis and pregnancy; the pathophysiology of sexually transmitted diseases (AIDS, syphilis, gonorrhoea); and the etiology and pathogenesis of cancer.	

BP204T Pharmaceutical Organic Chemistry

60 hours

Structure, nomenclature, preparation and reactions of organic compounds; functional groups; stereochemistry and reaction mechanisms relevant to drug molecules.

Unit 1	Aliphatic Saturated Hydrocarbons	12 h
	Alkanes — preparation (Wurtz, Kolbe, Clemmensen and Wolff—Kishner reactions), chemical reactions and the mechanism of free-radical halogenation, with pharmaceutical applications (liquid, soft and hard paraffin); and cycloalkanes — Baeyer's strain theory, the Coulson—Moffitt modification and the Sachse—Mohr theory.	
Unit 2	Aliphatic Unsaturated Hydrocarbons	12 h
	Alkenes — preparation, chemical reactions, the mechanism of electrophilic addition, Markovnikov's and anti-Markovnikov's rules and ozonolysis; and conjugated dienes — stability, the Diels—Alder reaction, and 1,2- and 1,4-addition reactions.	
Unit 3	Alkyl Halides	12 h
	Nucleophilic substitution (SN1 and SN2) and elimination (E1 and E2) reactions — mechanism, kinetics, substrate structure, solvent effect and stereochemistry; Zaitsev's rule; and the comparison of substitution versus elimination.	
Unit 4	Benzene & Its Derivatives	12 h
	IUPAC nomenclature and the structure of benzene, the molecular-orbital picture, resonance, aromaticity and Hückel's rule; electrophilic aromatic substitution (nitration, halogenation, Friedel—Crafts alkylation and acylation, sulphonation); and the effect of substituents on reactivity and orientation.	
Unit 5	Carbonyl Compounds	12 h
	Aldehydes and ketones — preparation and properties, nucleophilic addition, aldol and crossed-aldol condensation, Cannizzaro, benzoin and Perkin reactions, and oxidation and reduction; with pharmaceutical applications (chloral, paraldehyde, ketoprofen).	

BP205T Pharmacognosy and Phytochemistry

60 hours

Chemistry, biosynthesis, isolation and analysis of secondary metabolites — alkaloids, glycosides, flavonoids, tannins, volatile oils and resins.

Unit 1	Metabolic Pathways & Biogenetic Studies	10 h
	The basic metabolic pathways and biosynthesis of secondary metabolites — the shikimic-acid, acetate and amino-acid pathways; the use of radioactive isotopes in biogenetic studies; and pathway-prediction and modern genetic tools such as CRISPR/Cas9.	
Unit 2	Primary Metabolites	12 h
	Pharmacognostic study of drugs containing primary metabolites — carbohydrates (acacia, agar, tragacanth, honey), proteins and enzymes (gelatin, casein, papain, bromelain, streptokinase), and lipids (castor oil, olive oil, cocoa butter, wool fat, beeswax).	

Unit 3	Secondary Metabolites	12 h
	Pharmacognostic study of drugs containing secondary metabolites — alkaloids (Vinca, Rauwolfia, Opium), volatile oils (lemongrass, clove, cinnamon), tannins, resins (guggul, asafoetida), glycosides (senna, liquorice, digitalis), and flavonoids and terpenoids.	
Unit 4	Extraction Methods for Medicinal Plants	12 h
	Conventional extraction — infusion, decoction, maceration, percolation, reflux, distillation and Soxhlet and successive-solvent extraction; and modern methods — supercritical-fluid, microwave-assisted, ultrasonic-assisted, enzyme-assisted and pressurized-liquid extraction.	
Unit 5	Isolation, Identification & Characterization	14 h
	Separation and isolation techniques (planar, column, preparative TLC and flash chromatography); identification by phytochemical, chromatographic and spectroscopic techniques; TLC/HPTLC fingerprinting and markers; and the screening of alkaloids, glycosides, saponins, tannins, flavonoids and steroids.	

BP206T Physical Pharmaceutics

45 hours

Physicochemical properties of drugs — solubility, states of matter, phase equilibria, surface and interfacial phenomena, rheology, and reaction kinetics and stability.

Unit 1	Solubility & Buffers	9 h
	Solubility expression and solute—solvent interactions, solubility of solids, liquids and gases, Raoult's law and factors affecting solubility; the effect of pH, partition coefficient and critical solution temperature; and buffers — the buffer equation, buffer capacity, preparation and indicators.	
Unit 2	Interfacial Phenomena	8 h
	Surface and interfacial tension and their measurement, surface free energy, spreading coefficient, surface-active agents, HLB and detergency; adsorption at solid and liquid interfaces (contact angle, wetting); and the electric double layer, Nernst and zeta potential.	
Unit 3	Colloidal & Coarse Dispersions	12 h
	Colloidal dispersions — types, and optical, kinetic and electrical properties and stability; and coarse dispersions — suspensions (Stokes' law, sedimentation, flocculation) and emulsions (theories of emulsification and stabilization, and physical instabilities such as creaming, coalescence and phase inversion).	
Unit 4	Rheology	8 h
	Newtonian and non-Newtonian systems; thixotropy and negative thixotropy; the determination of rheological properties with single- and multi-point viscometers; and viscoelasticity and the applications of rheology in pharmacy.	
Unit 5	Micromeritics	8 h
	Particle size and size distribution, particle shape and surface area and their determination; and the flow properties of powders — determination, significance and methods of enhancement.	

SECOND YEAR

SEMESTER III

BP301T Introduction to Machine Learning in Pharmaceutical Sciences

30 hours · NEW in NEP 2020

Core machine-learning concepts; supervised and unsupervised learning; model building and evaluation; applications of ML in drug discovery, formulation and pharmaceutical data.

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| Unit 1 | Foundations of Machine Learning | 6 h |
| | Definition and scope of Artificial Intelligence, Machine Learning and Data Science; types of learning (supervised, unsupervised, reinforcement); features and labels, training and testing data; model building and prediction; train—test split, overfitting and underfitting; the bias—variance trade-off; and the basic ML workflow. | |
| Unit 2 | Regression Models in Healthcare | 6 h |
| | Predictive modelling for continuous outcomes — linear and multiple linear regression, model coefficients and their interpretation, residuals and goodness-of-fit; performance metrics (MSE, RMSE, R ²); and implementation on pharmaceutical data (dose—response relationships, drug-dissolution rates, PK-parameter estimation) using Python libraries such as scikit-learn. | |
| Unit 3 | Classification Models in Clinical Applications | 6 h |
| | Logistic regression, probability output and threshold selection; the confusion matrix and metrics (accuracy, sensitivity, specificity, precision, recall); ROC curve and AUC; k-nearest neighbours; and clinical examples such as adverse-drug-reaction and disease-risk prediction. | |
| Unit 4 | Tree-Based Models & Ensemble Learning | 6 h |
| | Decision trees (structure, splitting criteria, decision paths and feature importance); random forests and the ensemble concept; advantages and limitations of tree-based models; and applications such as ADR risk stratification, patient classification and treatment-outcome prediction. | |
| Unit 5 | Unsupervised Learning & Case Studies | 6 h |
| | The concept of unsupervised learning; clustering and K-means, choosing the number of clusters and interpreting cluster outputs; and a mini-case study integrating regression, classification or clustering on healthcare datasets for patient segmentation and drug grouping. | |

BP302T Environmental Sciences

15 hours

Ecosystems and biodiversity; environmental pollution and its control; sustainability and green practices relevant to the pharmaceutical industry.

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| Unit 1 | Environmental Pollution | 3 h |
| | The definition, scope and importance of environmental studies; the types, causes, effects and control measures of air, water, soil, noise and nuclear pollution; solid-waste and hazardous-waste management in the pharmaceutical setting; and the pharmacist's role in conservation and the sustainable use of resources. | |
| Unit 2 | Pharmaceutical Waste and Effluent Management | 3 h |
| | Types of pharmaceutical waste — chemical, expired drugs, packaging and biomedical waste; the Biomedical Waste Management Rules (2016) and CPCB guidelines; the design and functioning of an Effluent Treatment Plant (ETP); and water-purification methods used in pharmaceutical settings (reverse osmosis, UV, distillation and filtration). | |
| Unit 3 | Environmental Impact of the Pharmaceutical Industry | 3 h |
| | Sources of pollution in pharmaceutical manufacturing; solid, liquid and gaseous waste streams; the environmental risks posed by active pharmaceutical ingredients (APIs) and their dosage forms; and the impact of pharmaceutical residues on ecosystems and human health. | |
| Unit 4 | Sustainability in the Pharmaceutical Sector | 3 h |
| | Principles of sustainable development as applied to pharma; the principles and practices of green pharmacy; and energy conservation and resource optimisation across manufacturing operations. | |
| Unit 5 | Government Policies, Compliance and Practical Exposure | 3 h |
| | Environmental law — the Environment (Protection) Act 1986 and the Water (Prevention and Control of Pollution) Act; the National Green Tribunal and regulatory bodies (CPCB, SPCB); government initiatives including Swachh Bharat Abhiyan, the Namami Gange river-rejuvenation programme and Jal Jeevan Mission; and the ISO-14000 series. | |

BP303T Ethics and Universal Human Values

15 hours

Professional ethics; moral values and human conduct; ethical decision-making in pharmacy practice and research.

Unit 1	Introduction to Value Education	3 h
	The concept, definition and need for value education; the content and process of value education; and the application of human values in everyday personal, social and professional life.	
Unit 2	Self-Exploration and Human Aspirations	3 h
	Self-exploration as the means of value education; the development of a positive attitude and self-confidence; and a right understanding of happiness and prosperity.	
Unit 3	Harmony in the Human Being	3 h
	The human being as more than the physical body; harmony between the Self ('I') and the Body; and understanding the co-existence of the Self and the Body.	
Unit 4	Harmony in the Individual and Society	3 h
	Understanding the needs of the Self and of the Body and their respective activities; the family as the basic unit of human interaction and the role of values in relationships; and the foundations of respect in relationships — affection, kindness, guidance, reverence, glory, gratitude and love.	
Unit 5	Harmony in Society and Nature	3 h
	The comprehensive human goal and the five dimensions of human endeavour; harmony in nature and the four orders in nature; and a holistic perception of harmony in existence.	

BP304T General Pharmacology

45 hours

Principles of drug action; pharmacokinetics and pharmacodynamics; routes of administration; introduction to autonomic nervous system pharmacology.

Unit 1	Introduction to Pharmacology	8 h
	Definition, historical perspective and the branches of pharmacology; the nature and sources of drugs; the International Classification of Diseases (ICD) and International Non-proprietary Names (INN); the concepts of generic medicines, essential drugs and rational drug use together with the Indian government's initiatives to promote them; and the routes of drug administration with their advantages and disadvantages.	
Unit 2	Pharmacokinetics	7 h
	Drug absorption and its mechanisms, membrane transporters, bioavailability and bioequivalence and the factors affecting absorption; drug distribution, volume of distribution, storage sites and plasma-protein binding; biotransformation — microsomal and non-microsomal metabolism, the cytochrome P450 system, phase I and II reactions, first-pass metabolism, entero-hepatic cycling and prodrugs; and drug excretion and its kinetics.	
Unit 3	Pharmacodynamics	10 h
	Types and mechanisms of drug action and the dose—response relationship; receptor theories, structure, classification and regulation of receptors, spare receptors, and the concepts of agonist, inverse agonist, partial agonist and antagonist; signal-transduction mechanisms; factors modifying drug action including tachyphylaxis, idiosyncrasy, tolerance, dependence and addiction, and combined effects (additive and synergistic); adverse drug reactions and their types; and drug—drug interactions, both pharmacokinetic and pharmacodynamic.	
Unit 4	Drug Discovery and Evaluation of New Drugs	12 h
	Drug discovery and the preclinical evaluation of new drugs; human-relevant screening techniques including reconstructed human epidermis, organ-on-a-chip models, skin-irritancy testing by reconstructed corneal epithelium and skin-corrosivity testing by the Direct Peptide Reactivity Assay; and the advantages and disadvantages of in vitro and in silico pharmacological screening.	
Unit 5	Recent Trends in Pharmacology and Toxicology	8 h
	Chronopharmacology — the biological clock, types of rhythms, and the hormones, diseases and drugs affected by circadian rhythm, with an introduction to chronokinetics and chronotherapeutics; the principles, applications and scope of pharmacogenomics, gene therapy, biosimilars and precision medicine; and toxicology — its branches, classification of poisons and antidotes, the general principles of treating acute and heavy-metal poisoning, preclinical toxicity testing (acute, sub-acute, chronic and carcinogenicity) per OECD norms, genotoxicity and teratogenicity, and safety pharmacology per ICH and OECD guidelines.	

BP305T Heterocyclic Compounds and Stereochemistry

45 hours

Chemistry of heterocyclic ring systems found in drugs; stereochemistry, isomerism and optical activity, and their relevance to drug action.

- Unit 1 Carboxylic Acids, Amines and Polynuclear Aromatic Hydrocarbons** 15 h
Aliphatic and aromatic carboxylic acids — preparation (oxidation of alcohols, carbonation of Grignard reagents, the Kolbe—Schmidt reaction), acidity and the effect of substituents, and reactions including nucleophilic acyl substitution, decarboxylation and the Hell—Volhard—Zelinsky reaction, with the pharmaceutical applications of benzoic, salicylic and acetylsalicylic acid; aliphatic and aromatic amines — preparation, basicity and characteristic reactions; and polynuclear aromatic hydrocarbons, their classification and synthesis including the Haworth synthesis.
- Unit 2 Alcohols and Phenols** 7 h
Preparation of alcohols including oxymercuration—demercuration and the reduction of carbonyl compounds; the comparative acidity of phenols versus alcohols; the characteristic reactions of phenols including the Reimer—Tiemann reaction, halogenation and nitration; and the pharmaceutical applications of glycerine, thymol and paracetamol.
- Unit 3 Stereochemistry** 6 h
Optical activity and chirality; enantiomerism, diastereoisomerism and meso compounds; elements of symmetry; optical isomerism in compounds with one and two chiral centres; and the R/S and D/L systems of nomenclature.
- Unit 4 Conformational Analysis and Geometrical Isomerism** 10 h
Conformational isomerism in ethane, n-butane and cyclohexane, including axial and equatorial bonds and ring inversion; geometrical isomerism and cis—trans (E/Z) nomenclature; and the influence of stereochemistry on drug action.
- Unit 5 Heterocyclic Chemistry** 7 h
The nomenclature and classification of heterocyclic systems; the aromaticity, synthesis and reactivity of five-membered rings — the electrophilic substitution reactions of pyrrole, furan and thiophene; six-membered rings including pyridine; fused systems such as indole, quinoline and isoquinoline; and their occurrence in medically important molecules.

BP306T Pharmaceutical Dosage Forms I

45 hours

Formulation, manufacture and evaluation of solid and liquid dosage forms — tablets, capsules, solutions, suspensions and emulsions.

- Unit 1 Fundamentals of Dosage-Form Development** 7 h
Pre-formulation studies — the concept, need and parameters assessed; drug—excipient compatibility studies; packaging selection for the various dosage forms; drug-product and container-closure interaction; and an introduction to the stability guidelines for new drug substances and products.
- Unit 2 Compressed Solids — Tablets** 12 h
Tablet types and the granulation routes (wet, dry and direct compression); excipients and their roles; tooling types and specifications; compression machinery and process parameters; and the in-process and finished-product evaluation of tablets.
- Unit 3 Tablet Coating and Defects** 12 h
Sugar coating, film coating and enteric coating — materials, processes and equipment; specialised coating techniques; tablet-coating defects, their causes and remedies; and the evaluation of coated tablets.
- Unit 4 Capsules** 7 h
Hard gelatin capsules — formulation design, capsule shell composition and sizes, and filling methods (manual, semi-automatic and automatic); soft gelatin capsules — formulation, manufacture and applications; and the quality control and evaluation of capsule dosage forms.
- Unit 5 Modified-Release Dosage Forms** 7 h
The rationale for sustained and controlled release; the polymers used in modified-release systems; matrix, reservoir and osmotic approaches; and the formulation and evaluation of sustained- and controlled-release products.

BP307T Pharmaceutical Engineering

45 hours

Unit operations — flow of fluids, heat and mass transfer, size reduction, mixing, drying, filtration, distillation and evaporation; equipment and processes.

Unit 1	Fluid Flow and Size Reduction	12 h
	The principle, construction, working, advantages, disadvantages and pharmaceutical applications of equipment for the flow of fluids and for size reduction and size separation — including the laws governing size reduction, and mills, sieves and classifiers used in pharmaceutical practice.	
Unit 2	Heat Transfer and Mixing	12 h
	The principle, construction, working, advantages, disadvantages and pharmaceutical applications of heat-transfer equipment and of mixing equipment for liquids, semisolids and solids.	
Unit 3	Filtration, Crystallization and Centrifugation	12 h
	The theory and mechanisms of filtration, filter media and filter aids; crystallization theory and equipment; centrifugation; and the pharmaceutical applications of each.	
Unit 4	Evaporation, Drying and Distillation	5 h
	The principle, construction and working of evaporators, dryers and distillation equipment, together with their pharmaceutical applications.	
Unit 5	Materials and Material Handling	4 h
	Materials of construction for pharmaceutical plant; material-handling equipment and techniques including conveyors, hoists and automated guided vehicles (AGVs); storage systems such as bins and silos in warehouses; and safety considerations in material handling.	

BP308T Pharmaceutical Microbiology

45 hours

Structure and classification of microorganisms; sterilization and disinfection; aseptic techniques; microbial assays and sterility testing.

Unit 1	Introduction to Pharmaceutical Microbiology	9 h
	The role of microorganisms in pharmaceutical science; the structure, classification and identification of bacteria, fungi, viruses and protozoa; microscopy and staining techniques; and microbial cultivation, isolation and enumeration.	
Unit 2	Sterilization and Aseptic Technique	9 h
	Physical and chemical methods of sterilization — moist and dry heat, radiation, filtration and gaseous sterilization; the validation and monitoring of sterilization processes; and biological and chemical indicators.	
Unit 3	Evaluation of Microbiological Contamination	9 h
	Sources and control of contamination across water, raw materials, facility, packaging, equipment and personnel; environmental monitoring; and the microbial limit tests applied to pharmaceutical products.	
Unit 4	Microbial Control, Disinfectants and Aseptic Areas	9 h
	Designing the aseptic area — laminar-flow equipment, clean-area classification and air handling; and disinfectants, antiseptics and preservatives, their evaluation and the factors affecting their antimicrobial activity.	
Unit 5	Sterility Testing and Microbial Assays	9 h
	Sterility testing of pharmaceutical products and the interpretation of results; microbiological assays of antibiotics and vitamins; and the use of biological indicators in process validation.	

SEMESTER IV

BP401T Herbal Drug Technology

45 hours

Standardization, formulation and evaluation of herbal drugs; nutraceuticals and cosmeceuticals; regulatory aspects and quality control of herbal products.

Unit 1	Plant Tissue Culture and Standardized Extracts	10 h
	Plant tissue culture as an alternative source of medicine; an introduction to biomanufacturing; and the optimization and production of standardized extracts of medicinal plants, including strategies for preparing extracts of a desired quality.	
Unit 2	Quality Control of Herbal Raw Material	10 h
	Standardization parameters for crude drugs; TLC fingerprinting of representative drugs such as Shatavari,	

Licorice, Neem and Haritaki; and the analytical approaches used to establish the identity, purity and strength of herbal raw material.

Unit 3	Herbal Formulations, Excipients and Cosmetics	7 h
	Herbal formulations and the excipients used in them; and herbal agents in skincare, hair care and oral-hygiene products, together with their formulation and evaluation.	
Unit 4	DNA Fingerprinting and Authentication	10 h
	Molecular markers in the quality control of herbal drugs — including rbcL, matK and SCAR markers; DNA barcoding and fingerprinting for species authentication; and their role in detecting adulteration.	
Unit 5	Herbal Drug Safety, Interactions and Regulation	8 h
	Herb—drug interactions, intolerance and toxicity; pharmacovigilance of herbal medicines; and the regulatory framework governing herbal products, including AYUSH requirements and quality guidelines.	

BP402T Medicinal Chemistry

45 hours

Drug-design principles; structure—activity relationships (SAR); chemistry, synthesis and mechanism of major therapeutic drug classes.

Unit 1	Fundamentals of Medicinal Chemistry	7 h
	The development of drug classes — chemical classification, structure and uses; structure—activity relationships (SAR); physicochemical properties and drug action; and the concepts of chelation, bioisosterism and protein binding.	
Unit 2	Drugs Acting on the Autonomic Nervous System	15 h
	The chemistry, classification, SAR and synthesis of adrenergic and cholinergic agents — including epinephrine, phenylephrine, dopamine, methyldopa, clonidine, dobutamine, isoproterenol, terbutaline, salbutamol, naphazoline, oxymetazoline and xylometazoline — together with their therapeutic uses.	
Unit 3	Cholinergic and Anticholinergic Agents	9 h
	The chemistry, SAR and synthesis of cholinergic agonists and cholinesterase inhibitors — including neostigmine, pyridostigmine, tacrine hydrochloride and ambenonium chloride — and of anticholinergic and antispasmodic agents.	
Unit 4	Cardiovascular Agents	6 h
	The chemistry, classification and SAR of antianginal, antiarrhythmic and antihypertensive agents — including the calcium-channel blockers diltiazem, nifedipine, amlodipine and felodipine — and of vasodilators.	
Unit 5	Diuretics and Related Agents	8 h
	The chemistry, classification, SAR and synthesis of diuretic agents — including chlorothiazide, hydrochlorothiazide and hydroflumethiazide — together with carbonic-anhydrase inhibitors, loop diuretics and potassium-sparing agents.	

BP403T Pharmaceutical Biotechnology

45 hours

Recombinant DNA technology; fermentation and production of biologicals; enzymes, vaccines, monoclonal antibodies and biopharmaceuticals.

Unit 1	Introduction to Pharmaceutical Biotechnology	9 h
	Biotechnology in the pharmaceutical sciences; protein structure and function; enzymes and their pharmaceutical applications; and immobilization techniques and their industrial uses.	
Unit 2	Genetic Engineering and Recombinant DNA Technology	9 h
	The principles of genetic engineering; recombinant DNA technology, vectors and cloning strategies; the polymerase chain reaction (PCR) and its applications; and mutations and their types.	
Unit 3	Microbial Biotransformation and Fermentation Technology	9 h
	Microbial biotransformation; the principles of fermentation and process control; fermenter design and operation; and the downstream processing and recovery of fermentation products.	
Unit 4	Blood Products, Gene Therapy and Personalized Medicine	9 h
	Blood products — collection, processing and storage; gene therapy — types, methodologies, delivery systems and ethical considerations; and genomics, personalized medicine and the emerging role of artificial intelligence within it.	

Unit 5	Immunology, Vaccines and Sera	9 h
The immune system and the immune response; antigens and antibodies; hypersensitivity; vaccines and sera — their classification, production, standardization and storage; and monoclonal antibodies and their therapeutic applications.		

BP404T Social Pharmacy and Public Health

30 hours

Public health, epidemiology and national health programmes; preventive healthcare, nutrition and health education; the pharmacist in the community.

Unit 1	Introduction to Social Pharmacy and Public Health	6 h
The definition, scope and importance of social pharmacy and its place as a multidisciplinary field; the concepts of health and disease; and the determinants of health within the community.		
Unit 2	Health Systems, Policy and Pharmacoepidemiology	6 h
The structure of health systems and national health policy; the basics of epidemiology — endemic, epidemic and pandemic patterns, morbidity and mortality rates, and measures such as the odds ratio; and the principles of pharmacoepidemiology.		
Unit 3	Preventive Healthcare and Communicable Diseases	6 h
Immunization services, screening programmes and lifestyle counselling; health promotion and education, including the development of effective health-education materials; and the prevention and control of communicable diseases.		
Unit 4	Non-Communicable Diseases, Nutrition and National Programmes	6 h
Non-communicable diseases and their risk factors; nutrition and malnutrition, nutritional-deficiency disorders and food safety; mental health; and the national health programmes addressing them.		
Unit 5	Pharmacoeconomics and Professional Roles	6 h
The principles of pharmacoeconomics; the rational use of medicines; and the professional roles and responsibilities of the pharmacist within the community and the wider public-health system.		

BP405T Systemic Pharmacology I

45 hours

Pharmacology of drugs acting on the autonomic and central nervous systems and the cardiovascular system.

Unit 1	Drugs Acting on the Peripheral Nervous System	10 h
The pharmacology of drugs acting on the peripheral nervous system — cholinergic and anticholinergic agents, adrenergic and antiadrenergic agents, neuromuscular blockers and local anaesthetics — with their mechanisms of action, adverse effects and therapeutic uses.		
Unit 2	Drugs Acting on the Cardiovascular System	10 h
The pharmacology of antihypertensives, antianginal and antiarrhythmic agents, drugs used in heart failure and antihyperlipidaemic agents — with their classification, mechanisms of action, adverse effects and therapeutic uses.		
Unit 3	Drugs Acting on Blood and the Kidney	10 h
Haematinics, anticoagulants, antiplatelet and fibrinolytic agents and plasma expanders; and diuretics and antidiuretics — with their mechanisms, adverse effects and therapeutic applications.		
Unit 4	Autacoids and Related Drugs	9 h
The pharmacology of histamine and antihistamines, 5-HT and its antagonists, prostaglandins and leukotrienes; and the non-steroidal anti-inflammatory drugs and drugs used in gout.		
Unit 5	Anti-inflammatory and Antirheumatic Agents	6 h
Disease-modifying antirheumatic drugs (DMARDs) and immunosuppressants; and the mechanism of action, adverse effects and therapeutic uses of the important anti-inflammatory and antirheumatic agents.		

THIRD YEAR

SEMESTER V

BP501T Biomedical Chemistry

45 hours

Chemistry and mechanism of biologically active molecules; drug metabolism; the molecular basis of drug action.

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| Unit 1 | CNS Depressants — General Anaesthetics, Sedatives and Hypnotics | 10 h |
| | The development of CNS drug classes — chemical classification, structure, uses and the SAR of selected classes, with the synthesis of representative agents. General anaesthetics including halothane, methoxyflurane, enflurane, sevoflurane, isoflurane, desflurane, methohexital, thiamylal, thiopental and ketamine, together with newer agents such as remimazolam, fospropofol and dexmedetomidine; and the sedatives and hypnotics, including the barbiturates (phenobarbital, amobarbital, butabarbital, pentobarbital, secobarbital) and ramelteon. | |
| Unit 2 | Psychopharmacological Agents | 12 h |
| | The chemistry, classification, SAR and synthesis of antipsychotic agents — the phenothiazines including promazine, chlorpromazine, triflupromazine and thioridazine — together with antidepressants, anxiolytics, anticonvulsants and antiparkinsonian agents, and their therapeutic applications. | |
| Unit 3 | Antibacterial and Antitubercular Agents | 8 h |
| | The chemistry, classification and SAR of the fluoroquinolones including levofloxacin, and of the antitubercular agents bedaquiline, linezolid and delamanid, together with sulphonamides and other synthetic antibacterials. | |
| Unit 4 | Beta-Lactams, Tetracyclines and Cephalosporins | 6 h |
| | The structure, classification and structure—activity relationships of the penicillins, tetracyclines and cephalosporins, together with their mechanisms of action, spectrum of activity and the basis of bacterial resistance. | |
| Unit 5 | Antineoplastic and Immunosuppressant Agents | 9 h |
| | The chemistry, classification and SAR of the antineoplastic agents — including methotrexate, azathioprine, dactinomycin and daunorubicin — covering antimetabolites, alkylating agents, antibiotics and plant-derived agents, together with their mechanisms and toxicities. | |

BP502T Industrial Pharmacognosy

45 hours

Large-scale production, processing and standardization of natural drugs; industrial applications of plant products; screening and quality control.

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| Unit 1 | Herbal Industries, Institutions and Trade | 8 h |
| | A general introduction to the herbal industries, the institutions supporting them and the structure of the herbal trade in India and internationally. | |
| Unit 2 | Commercial Production and Standardization of Botanicals | 10 h |
| | The commercial production and standardization of botanicals such as Ashwagandha, Turmeric, Ginseng and Amla; the significance of AYUSH/WHO-GMP, GLP and USFDA requirements; and the production of standardized herbal extracts for antistress, antidiabetic, antihyperlipidaemic and immunomodulatory applications. | |
| Unit 3 | Volatile Oils and AYUSH Formulations | 12 h |
| | The commercial production and standardization of volatile oils including eucalyptus, lavender, peppermint and rosemary oils; and the preparation and standardization of AYUSH formulations, together with the cultivation and processing of medicinal and aromatic plants in India. | |
| Unit 4 | Analytical Techniques for Phytoconstituents | 8 h |
| | Modern analytical techniques applied to natural products — UV and IR spectroscopy, NMR spectroscopy, mass spectrometry and atomic spectroscopy — and their use in the characterisation of plant constituents. | |
| Unit 5 | Global Regulation and Pharmacopoeial Monographs | 7 h |
| | The identification and analysis of bioactive phytoconstituents; international regulation of traditional medicine including the EMA, TGA (Australian Regulatory Guidelines for Complementary Medicines) and Natural Health Products (Canada); harmonization challenges and mutual recognition; safety, efficacy and pharmacovigilance in herbal-product regulation; and monographs in the Indian Pharmacopoeia, USP Herbal Medicine and Dietary Supplement, and the Ayurvedic and Unani Pharmacopoeias of India. | |

BP503T Innovation and Startup Ecosystem

30 hours · NEW in NEP 2020

Entrepreneurship and innovation; developing and validating a business idea; startup funding and the ecosystem; intellectual property and commercialisation for pharmacy graduates.

Unit 1	Introduction to Innovation & Entrepreneurship Defining innovation and entrepreneurship; types of innovation (product, process, business-model, social); invention versus innovation; the importance of innovation for economic growth and solving societal problems; disruptive technologies; and the startup ecosystem — entrepreneurs, incubators/accelerators, mentors, investors, government and academia.	6 h
Unit 2	Ideation & Opportunity Identification Identifying problems and market gaps through observation, empathy mapping and user interviews; market-research basics; generating ideas with brainstorming, SCAMPER, mind mapping and design-thinking principles; and opportunity analysis and feasibility — market sizing, competitive analysis and SWOT.	6 h
Unit 3	Building an MVP & Validation Lean-startup methodology and the Build—Measure—Learn loop; the concept, scope and types of a Minimum Viable Product; rapid-prototyping tools and UX basics; and validation through customer interviews, A/B testing, and the decision to pivot or persevere.	6 h
Unit 4	Business Models & Startup Operations The Business Model Canvas and value-proposition design; legal structures (sole proprietorship, partnership, private limited); intellectual property (patents, trademarks, copyrights); startup funding (bootstrapping, angel investors, venture capital); and team building and mentorship.	6 h
Unit 5	Scaling, Ecosystem Engagement & Future Trends Growth strategies and scaling — marketing and sales, user acquisition and retention; exit strategies (acquisition, IPO); engaging with the startup ecosystem through networking, competitions and incubators; and future trends including artificial intelligence and other emerging technologies.	6 h

BP504T Pharmaceutical Dosage Form II

30 hours

Formulation and evaluation of semisolid, sterile (parenteral, ophthalmic) and controlled-release dosage forms.

Unit 1	Monophasic Liquids The need for, and the advantages and limitations of, liquid dosage forms; monophasic versus biphasic systems and solubility-enhancement techniques; vehicles and solvents including pharmaceutical waters (types, manufacture and quality control of purified and distilled water) and solvent classes by toxicity; the formulation, manufacture and quality control of solutions, syrups and elixirs and of powders for reconstitution; and measuring, filling and packaging, container—closure integrity and automation in liquid manufacturing.	6 h
Unit 2	Biphasic Liquids — Suspensions The formulation and manufacture of suspensions — additives and the classification of suspending agents; in-process and finished-product quality control; instabilities and packaging; and advances including nanosuspensions, dry powders for reconstitution and raft-forming systems.	6 h
Unit 3	Biphasic Liquids — Emulsions The formulation and manufacture of emulsions — additives and the classification of emulsifying agents; in-process and finished-product quality control; instabilities and packaging; and advances including nano-emulsions, micro-emulsions and SMEDDS/SNEDDS.	6 h
Unit 4	Pressurised Dosage Forms and Inhalers Aerosols and metered-dose inhalers — concepts, propellant classification and selection, valves and containers, and the formulation, manufacture and quality control of the product, including leak testing, spray pattern, delivered dose and particle-size/aerodynamic performance; together with dry-powder inhalers and their formulation and evaluation.	6 h
Unit 5	Semisolid Dosage Forms The theory of semisolid dosage forms — definition and purpose, drug-permeation pathways through skin, factors affecting permeation and physical and chemical permeation enhancers; the formulation, manufacture and evaluation of ointments (including base selection), creams, gels and jellies, pastes, and suppositories and pessaries; and advances such as xerogels and emulgels.	6 h

BP505T Pharmaceutical Quality Assurance

45 hours

Good Manufacturing Practices (GMP); quality control and quality management; documentation, validation and regulatory compliance.

Unit 1	Quality Assurance and Quality Management Systems The concepts of quality assurance, quality control and total quality management; quality-management systems and QSEM, with particular emphasis on the ICH Q-series guidelines; and the principles underlying good manufacturing practice.	10 h
Unit 2	Organization, Personnel, Premises and Materials Organization and personnel responsibilities; premises and plant layout; materials management including User Requirement Specifications (URS); and the handling and maintenance of equipment and facilities under GMP.	10 h
Unit 3	Quality Control and Good Laboratory Practices In-process and finished-product quality-control tests for tablets, capsules, liquids and semisolids; and Good Laboratory Practice — general provisions, organization and personnel, facilities, equipment and standard operating procedures.	10 h
Unit 4	Documentation, Complaints and Product Recall GMP documentation — the Batch Formula Record, Master Formula Record and Drug Master File, and the specifications for primary and secondary packing materials; and the handling and evaluation of complaints, returned goods, recalls and waste disposal.	8 h
Unit 5	Calibration and Validation The introduction, definitions, importance and general principles of calibration and validation; calibration of weights, measures and pH meters; qualification of the UV-visible spectrophotometer, electronic balance, IR spectrophotometer and HPLC; and the general principles of analytical method validation as per ICH Q2.	7 h

BP506T Systemic Pharmacology II

45 hours

Pharmacology of drugs acting on the respiratory, gastrointestinal, endocrine and reproductive systems; chemotherapy and autacoids.

Unit 1	Drugs Acting on the Central Nervous System Neurohumoral transmission in the CNS and the physiological roles of GABA and the other central neurotransmitters; and the pharmacology of general and local anaesthetics, sedative-hypnotics, antiepileptics, antiparkinsonian agents and analgesics — with their mechanisms, adverse effects and therapeutic uses.	10 h
Unit 2	Drugs Used in Psychiatry and Substance Abuse The classification, mechanism of action and adverse drug reactions of antipsychotics, antidepressants, anxiolytics and mood stabilisers; alcohol and disulfiram; and substance abuse, drug addiction and the general principles of de-addiction.	7 h
Unit 3	Chemotherapy The chemotherapy of infectious and neoplastic disease — general principles of antimicrobial therapy, sulphonamides and antibiotics, antitubercular, antileprotic, antifungal, antiviral, antimalarial and anthelmintic agents, together with antineoplastic agents and immunosuppressants, and the problem of drug resistance.	14 h
Unit 4	Drugs Acting on the Endocrine System The pharmacology of the anterior and posterior pituitary hormones; thyroid and antithyroid drugs; parathormone, calcitonin and vitamin D; insulin and the oral hypoglycaemic agents; ACTH and the corticosteroids; oral contraceptives, drugs acting on the uterus, and the management of PCOD.	10 h
Unit 5	Drugs Acting on the Gastrointestinal Tract Drugs used in peptic ulcer disease; drugs for constipation and diarrhoea; emetics and anti-emetics; and digestants, carminatives, appetizers and anorectics.	4 h

SEMESTER VI

BP601T Advanced Pharmacognosy

45 hours

Advanced study of natural products; marine and microbial drugs; herbal cosmetics; standardization and modern analytical techniques for phytopharmaceuticals.

Unit 1	Reverse Pharmacology and Integrative Approaches	6 h
	Reverse pharmacology and integrative approaches from the AYUSH perspective; the ethnopharmacological approach to bioprospecting; traditional-medicine databases including the AYUSH Research Portal, ICMR Standards on Indian Medicinal Plants, TKDL, NAPRALERT and Super Natural; molecular docking and ADMET screening of bioactives; and adjuvant therapy with herbals in metabolic and non-communicable disease.	
Unit 2	Metabolomics and Systems Biology	11 h
	An introduction to metabolomics and its tools; the application of NMR and HRMS; metabolomic profiling and dereplication studies; the role of metabolomics in quality control, the scientific validation of traditional claims and pharmacological evaluation; network pharmacology and systems-biology approaches to herbal medicine; and the significance of spectral libraries and chemoinformatics databases.	
Unit 3	Modern Techniques in Natural-Product Discovery	10 h
	The role of artificial intelligence, machine learning and big data in drug discovery from natural products; molecular docking, virtual screening and pharmacophore modelling; genomic and transcriptomic tools in medicinal-plant research; and high-throughput screening and bioautography.	
Unit 4	Validation and Development of Herbal Leads	12 h
	Bioactivity-guided fractionation, characterization and structure elucidation; the optimization of lead compounds for efficacy, safety and stability through SAR and QSAR modelling of semi-synthetic derivatives of salicin, artemisinin, piperine, papaverine and andrographolide; and the preclinical and clinical evaluation of herbal leads through to new-drug approval and post-market surveillance.	
Unit 5	Patenting of Natural Products	6 h
	Key terminology — patents, intellectual property rights, farmers' and breeders' rights, bioprospecting and biopiracy; the legal frameworks and challenges in patenting natural substances and traditional knowledge; the role of the Traditional Knowledge Digital Library (TKDL), the National Biodiversity Authority and the Nagoya Protocol; and case studies including the revocation of the U.S. turmeric wound-healing patent and the neem biopiracy case.	

BP602T Biopharmaceutics and Pharmacokinetics

45 hours

Drug absorption, distribution, metabolism and excretion (ADME); pharmacokinetic parameters and models; bioavailability and bioequivalence.

Unit 1	Introduction to Biopharmaceutics and Pharmacokinetic Parameters	10 h
	An introduction to biopharmaceutics and pharmacokinetics; and the pharmacokinetic parameters derived from the plasma drug-concentration versus time curve, together with the pharmacodynamic parameters that relate exposure to drug response.	
Unit 2	Drug Absorption	10 h
	The mechanisms of drug absorption through the gastrointestinal tract; and the physicochemical, physiological, pharmaceutical and patient-related factors that influence the rate and extent of absorption.	
Unit 3	Distribution and Elimination	10 h
	Drug distribution — tissue permeability, protein binding of drugs and the apparent volume of distribution; and elimination — drug metabolism and its basic pathways, together with renal and non-renal excretion and their kinetics.	
Unit 4	Bioavailability and Bioequivalence	9 h
	The definition and objectives of bioavailability and bioequivalence studies; the protocols for their assessment; and in vitro—in vivo correlation and its regulatory significance.	
Unit 5	Pharmacokinetic Modelling	6 h
	Compartment modelling — one- and two-compartment open models for intravenous and extravascular administration; multiple-dosage regimens and dosage adjustment; and non-linear pharmacokinetics.	

BP603T Intellectual Property Rights

30 hours

Patents, trademarks, copyrights and designs; IPR in the pharmaceutical industry; filing and protection of pharmaceutical innovations.

Unit 1	Introduction to Intellectual Property	6 h
	The definition and scope of intellectual property; its importance to the pharmaceutical sector; and the principal types of intellectual property and the rights each confers.	

Unit 2	Patents — Fundamentals and Process	6 h
	The definition and objectives of patents; the criteria for patentability including novelty, non-obviousness and utility; the types of patents and non-patentable inventions; and the patent-filing and prosecution process.	
Unit 3	Patent Laws and Acts	6 h
	An overview of the Indian Patents Act 1970 with its latest amendments and key provisions; its impact on the Indian pharmaceutical sector; and compulsory licensing, patent opposition and revocation.	
Unit 4	Trademarks, Copyrights and Designs	6 h
	Trademarks and their registration and protection; copyright and related rights; industrial designs; and geographical indications, with pharmaceutical examples of each.	
Unit 5	IPR in the Pharmaceutical Industry	6 h
	International IPR frameworks including TRIPS and the WIPO treaties; data exclusivity and patent-term extension; technology transfer and licensing; and case studies of intellectual-property disputes in pharmaceuticals.	

BP604T AI Applications in Pharmaceutical Sciences

30 hours · NEW in NEP 2020

Artificial intelligence in drug discovery, formulation and manufacturing; predictive modelling; AI tools and their real-world pharmaceutical applications.

Unit 1	AI in Natural Products & Pharmacognostic Data Modeling	6 h
	Representing crude-drug data (morphological, microscopic, phytochemical and chromatographic features) and structuring herbal datasets; classification models for authenticating crude drugs; regression models for predicting secondary-metabolite yield; AI in phytochemical screening and herb—drug-interaction prediction; and the limitations of predictive modelling in natural products.	
Unit 2	AI in Medicinal & Pharmaceutical Chemistry	6 h
	Converting molecular structures into numerical descriptors (MW, logP, HBD/HBA, TPSA); QSAR modelling on structured chemical datasets; regression and classification models for predicting biological activity (IC ₅₀ , solubility, ADMET) and toxicity; virtual screening and lead optimisation; and the limits of ML models in chemistry.	
Unit 3	AI in Drug Product Design & Performance Prediction	6 h
	Dosage-form development and formulation variables; machine learning in formulation optimisation and excipient selection; regression modelling for solubility and bioavailability enhancement; time—concentration modelling of drug release; stability-study design and degradation-trend modelling; and shelf-life estimation.	
Unit 4	AI in Process Monitoring & Production Systems	6 h
	Digital data acquisition in pharmaceutical production; Critical Quality Attributes and Critical Process Parameters; correlation analysis for process variability; logistic-regression models for batch pass/fail prediction; feature importance and predictive-maintenance concepts; and ethical and regulatory considerations in automated decision-making.	
Unit 5	AI in Pharmaceutical Analysis & Chemometrics	6 h
	Introduction to chemometrics and multivariate analytical data; spectroscopic data modelling (UV/IR interpretation); regression analysis in quantitative pharmaceutical analysis; chromatographic peak modelling; classification models for genuine-versus-counterfeit detection; and handling noise and variability in analytical datasets.	

BP605T Pharmaceutical Analysis

45 hours

Titrimetric and instrumental methods of analysis — spectroscopy, chromatography and electrochemical techniques.

Unit 1	Electrochemical Methods of Analysis	10 h
	Potentiometry — electrode potential and the electrochemical cell, the construction and working of reference, indicator and membrane electrodes, measurement of potential and pH, potentiometric titrations and end-point detection, and Karl Fischer titration; conductometry — the conductivity cell, conductometric titrations and applications; and polarography — residual, migration, diffusion and limiting currents, the dropping mercury electrode, the polarographic wave, the Ilkovic equation and applications.	
Unit 2	UV-Visible and Infrared Spectroscopy	10 h
	The fundamentals of spectroscopy — the properties of electromagnetic radiation and the electromagnetic spectrum; UV-visible spectroscopy — the Beer—Lambert law and its deviations, electronic transitions, chromophores and auxochromes, spectral shifts and solvent effects, instrumentation (sources, wavelength selectors, sample cells and detectors) and single- and multi-component pharmaceutical analysis; and IR spectroscopy — fundamental vibrational modes, factors affecting vibrations, dispersive and FTIR instrumentation with sample-handling techniques, and pharmaceutical applications.	

Unit 3	Fluorimetry The theory of fluorescence and phosphorescence; the factors affecting fluorescence including quenching; instrumentation of the spectrofluorimeter; and the pharmaceutical applications of fluorimetric analysis.	7 h
Unit 4	Chromatographic Techniques and Electrophoresis An introduction to chromatographic separation and its underlying principles; gel-filtration and affinity chromatography and their applications; and electrophoresis — the factors affecting electrophoretic mobility and the techniques of paper, gel and capillary electrophoresis with their applications.	8 h
Unit 5	Instrumental Chromatography Gas chromatography — theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications; high-performance liquid chromatography — theory, instrumentation, advantages and applications; and HPTLC — principle, instrumentation and applications.	10 h

BP606T Pharmaceutical Jurisprudence

45 hours

Drug laws and regulations — the Pharmacy Act, Drugs & Cosmetics Act and NDPS Act; professional ethics and regulatory bodies.

Unit 1	Drugs and Cosmetics Act 1940 and Rules 1945 The objectives and definitions of the Act; the legal definitions of the schedules to the Act and Rules; and the CDSCO guidelines governing the import and export of pharmaceuticals.	10 h
Unit 2	Schedules and Manufacturing Provisions The provisions of the Drugs and Cosmetics Act 1940 and Rules 1945 relating to the manufacture, sale and distribution of drugs; and the requirements of the principal schedules, including Schedule F and Part XII-B.	10 h
Unit 3	Offences, Penalties and Enforcement The offences created under the Act and the penalties prescribed; adulterated, spurious and misbranded drugs; and the powers of inspection, sampling and prosecution.	8 h
Unit 4	Regulatory Bodies and Authorities The Drugs Technical Advisory Board, the Central Drugs Laboratory and the Drugs Consultative Committee; government drug analysts and licensing authorities; and their respective constitution, powers and functions.	8 h
Unit 5	Allied Legislation and Professional Ethics The Pharmacy Act 1948 and the constitution and functions of the Pharmacy Council of India; the Narcotic Drugs and Psychotropic Substances Act; the Drugs and Magic Remedies (Objectionable Advertisements) Act; and the code of pharmaceutical ethics governing professional conduct.	9 h

FOURTH YEAR

SEMESTER VII

BP701T Biostatistics & Research Methodology

45 hours

Research design; sampling and data collection; statistical analysis and hypothesis testing; scientific writing and reporting of research.

Unit 1	Basic Concepts of Biostatistics	9 h
	The meaning of data and the methods of data collection, preprocessing and presentation; population and sample and the importance of sampling; probability and non-probability sampling methods; and the distinction between descriptive and inferential statistics.	
Unit 2	Descriptive Statistics	9 h
	The meaning and types of descriptive statistics; measures of central tendency and dispersion; the concept of degrees of freedom; and quartiles, skewness and kurtosis, with their interpretation in pharmaceutical data.	
Unit 3	Inferential Statistics and Hypothesis Testing	9 h
	Probability distributions and the normal curve; estimation and confidence intervals; the formulation of null and alternative hypotheses, level of significance and errors of the first and second kind; and parametric and non-parametric tests including the t-test, ANOVA and chi-square.	
Unit 4	Research Methodology and Study Design	12 h
	The research process and the formulation of a research problem and objectives; literature review; types of research and study design including observational, experimental and clinical designs; sample-size determination; and the design of experiments together with the ethical considerations governing research.	
Unit 5	Scientific Writing and Reporting	6 h
	The structure of a research report and scientific paper; referencing and citation practice; presentation of data through tables and graphs; plagiarism and research integrity; and the communication of findings to scientific and regulatory audiences.	

BP702T Cosmetics and Cosmeceuticals

30 hours

Formulation, evaluation and regulation of cosmetic and cosmeceutical products for skin, hair and oral care.

Unit 1	Classification and Dosage Forms of Cosmetics	6 h
	Cosmetics and cosmeceuticals and their classification — products for skin care, hair care, oral care, foot care and body cavities, together with decorative and cleansing cosmetics, perfumes and fragrances; the types of dosage form used for cosmetics; and the excipients commonly employed in them.	
Unit 2	Skin Cosmetics and Soaps	6 h
	Common skin problems — dry skin, oily skin, pimples and acne, pigmentation, prickly heat and sunburn — and the general composition, method of preparation, packing and evaluation of the corresponding skin cosmetics and cosmeceuticals, including herbal preparations; the types of soaps and syndet bars and their preparation and evaluation; and an introduction to perfumes and toiletries.	
Unit 3	Hair Cosmetics and Cosmeceuticals	6 h
	Common hair problems and the cosmetics addressing them; the types of shampoo, their general composition, preparation, packing and evaluation; and an introduction to hair oils, hair serums, conditioners, hair colours, depilatories and shaving products, together with herbal hair-care products.	
Unit 4	Oral, Nail, Eye and Body Cosmetics	6 h
	Problems of the oral cavity and the oral cosmetics and cosmeceuticals addressing them — the general composition, preparation, packing and evaluation of mouthwash and toothpaste, including herbal oral care; and cosmetics for nails, eyes, body odour, lip care and cleansing, together with intimate-hygiene products.	
Unit 5	Regulation of Cosmetics	6 h
	The role of the regulatory authorities governing cosmetics and cosmeceuticals — CDSCO and the US FDA; the Cosmetics Rules 2020; and the role of the Bureau of Indian Standards in cosmetic quality and labelling.	

BP703T AI in Clinical Applications

30 hours · NEW in NEP 2020

Application of artificial intelligence in clinical practice — clinical decision support, diagnostics, patient monitoring and personalised medicine.

Unit 1	AI in Pharmacokinetics & Dose Optimization Review of pharmacokinetic parameters (C _{max} , T _{max} , AUC, clearance); modelling concentration—time relationships with linear and multiple regression for dose adjustment by patient variables (age, weight, renal function); interpreting regression coefficients clinically; error metrics (RMSE, R ²); and the limits of linear modelling in nonlinear pharmacokinetics.	6 h
Unit 2	AI in Drug Safety & Pharmacovigilance Pharmacovigilance systems and real-world data formats (FAERS, EudraVigilance); frequency analysis and signal detection; logistic regression for ADR-risk prediction; the confusion matrix and clinical performance metrics (sensitivity, specificity, precision, recall); and bias and confounding in observational datasets.	6 h
Unit 3	AI in Personalized Medicine & Risk Stratification The concept of precision medicine; patient covariates and therapeutic response; logistic regression for disease-risk prediction; classifying responders versus non-responders; evaluation metrics in healthcare prediction; and the ethical implications of predictive modelling.	6 h
Unit 4	AI in Clinical Decision Support & Real-World Data The structure of Electronic Health Records (EHR); AI in Clinical Decision Support Systems (CDSS); regression models for outcome prediction and classification models for risk scoring; real-world data analytics; and the limitations, accountability and interpretability of AI in clinical environments.	6 h
Unit 5	Guided Supervised-Learning Project A guided project applying regression or classification models to a pharmaceutical or clinical dataset — problem definition, dataset selection, choice of predictor and outcome variables, data preprocessing, model building and evaluation, interpretation of results, and discussion of limitations, bias and ethics.	6 h

BP704T Modern Analytical Techniques

45 hours

Advanced instrumental analysis — NMR, mass spectrometry and hyphenated techniques, and their pharmaceutical applications.

Unit 1	Nuclear Magnetic Resonance Spectroscopy The principles of ¹ H-NMR and ¹³ C-NMR; the solvents used and sample preparation; chemical shift, spin—spin coupling and integration; instrumentation; and the interpretation of spectra in the structural elucidation of pharmaceutical molecules.	10 h
Unit 2	Mass Spectrometry Principles, fragmentation and the rules governing it; ionization techniques including electron impact, chemical ionization, MALDI, FAB and atmospheric-pressure ionization; mass analysers and detectors; and applications in pharmaceutical analysis and structure determination.	8 h
Unit 3	X-Ray Crystallography and Thermal Analysis The origin of X-rays and the basic aspects of crystals; X-ray crystallography and diffraction methods and their pharmaceutical applications; and thermal methods of analysis — their introduction, instrumentation, the factors affecting measurement and their applications.	10 h
Unit 4	Green Analytical Chemistry and Bioanalytical Methods The types of green solvents and the computational tools used to assess the greenness of analytical methods; and an introduction to bioanalytical method development — the extraction of drugs from biological matrices, and method validation for bioanalysis.	12 h
Unit 5	Bioequivalence Studies and Biosimilars The bioavailability and bioequivalence study protocol and its regulatory requirements; and an introduction to biosimilars and the analytical comparability exercise used to establish them.	5 h

BP705T Pharmacovigilance

45 hours

Drug-safety monitoring; adverse drug reaction reporting; signal detection; national and global pharmacovigilance programmes.

Unit 1	Fundamentals of Pharmacovigilance The definition, scope, aims and importance of pharmacovigilance; its historical development and the drug-safety	10 h
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disasters that shaped it; and the basic terminology of drug safety, including adverse events, adverse drug reactions and side effects.

Unit 2	Pharmacovigilance Systems and Regulatory Framework	10 h
	National and international pharmacovigilance systems — the Pharmacovigilance Programme of India (PvPI), the WHO Programme for International Drug Monitoring and the Uppsala Monitoring Centre; and the regulatory framework and reporting obligations that govern drug-safety monitoring.	
Unit 3	Adverse Drug Reactions	8 h
	The classification and mechanisms of adverse drug reactions; predisposing factors; causality assessment scales including the WHO-UMC and Naranjo scales; and severity and preventability assessment.	
Unit 4	Pharmacovigilance Tools and Allied Disciplines	7 h
	Safety databases and software including VigiBase, VigiFlow, Oracle Argus and OpenVigil; and immunovigilance together with the other disciplines of pharmacovigilance — materiovigilance, haemovigilance and vigilance of traditional medicines.	
Unit 5	Signal Detection, Risk Management and ICH	10 h
	Signal detection and data-mining methods; risk communication, evaluation and management, including Risk Management Plans and REMS; and the ICH guidelines relevant to pharmacovigilance, together with periodic safety-update reporting.	

BP706T Pharmacy Practice

45 hours

Clinical and hospital pharmacy; patient counselling; therapeutic drug monitoring; the pharmacist's role in patient care.

Unit 1	Introduction to Pharmacy Practice	8 h
	The definition, scope and evolution of pharmacy practice; the tiers of the healthcare system from primary health centres through to medical colleges; and the role of the pharmacist at each level of care.	
Unit 2	Hospital and its Organization	10 h
	The classification of hospitals and the organizational structure of a hospital; hospital committees and their functions; and the place of the pharmacy within the hospital's organization.	
Unit 3	Hospital Pharmacy and its Organization	9 h
	The definition and organizational structure of the hospital pharmacy; its location, layout and staffing; drug distribution systems including unit-dose and ward-stock methods; and hospital formulary and drug-information services.	
Unit 4	Community Pharmacy	9 h
	The organization and management of a community pharmacy; prescription handling and dispensing practice; over-the-counter medication and responsible self-medication; patient counselling and medication-adherence support; and inventory and business management.	
Unit 5	Clinical Pharmacy Services	9 h
	Ward-round participation and medication review; therapeutic drug monitoring; the identification and management of drug-related problems; patient medication history and drug-interaction screening; and pharmaceutical care planning and documentation.	

BP707T Regulatory Affairs

30 hours

Drug-approval processes; regulatory bodies (CDSCO, US FDA, ICH); dossier preparation and regulatory compliance for global markets.

Unit 1	Fundamentals of Regulatory Affairs	6 h
	An introduction to drug regulatory affairs; an overview of the principal regulatory agencies including the CDSCO, US FDA, EMA and PMDA; the organizational structure of regulatory bodies; and the role and responsibilities of the regulatory-affairs professional.	
Unit 2	Regulations, Laws and Acts	6 h
	The regulations, laws and acts governing pharmaceuticals; and the principal regulatory references including the Orange Book, the Purple Book, the Federal Register and the Code of Federal Regulations.	
Unit 3	Regulatory Requirements in Drug Development	6 h
	The regulatory requirements at each stage of drug development — preclinical studies, the Investigational New Drug application, the phases of clinical trials, and Good Clinical Practice; together with the ICH guidelines that apply.	

Unit 4	Dossier Preparation and the Common Technical Document The structure and modules of the Common Technical Document (CTD) and electronic CTD; the preparation and compilation of a registration dossier; and the New Drug Application and Abbreviated New Drug Application routes.	6 h
Unit 5	Global Registration and Post-Approval Activities Registration requirements in the major and emerging markets; post-approval changes, variations and supplements; labelling and packaging requirements; and regulatory inspections and compliance.	6 h

SEMESTER VIII

BP801T Ethical Considerations and Translational Applications of AI in Pharmacy 30 hours · NEW in NEP 2020

Ethics, bias, data privacy and governance in AI; translating AI research into pharmacy practice; responsible and regulatory aspects of AI in healthcare.

Unit 1	AI Lifecycle, Validation & Model Auditing The AI system lifecycle — data collection, preprocessing, modelling, validation, deployment and monitoring; the importance of data quality in healthcare datasets; training, testing and validation datasets and cross-validation; model drift, performance degradation and data leakage; documentation and reproducibility; and the basics of model auditing.	6 h
Unit 2	Regulatory Framework & Explainable AI AI in regulatory submissions; Explainable AI (XAI), transparency and interpretability; regulatory guidance on AI (the EU AI Act, FDA and CDSCO frameworks); accountability in automated decision systems; and risk-based classification of AI systems.	6 h
Unit 3	AI in Pharmacy Automation & Supply Chain AI in automated dispensing systems; inventory-prediction and demand-forecasting models; medication-adherence monitoring; AI in supply-chain risk prediction and pharmaceutical logistics; and the advantages, limitations, legal and privacy considerations of automation.	6 h
Unit 4	AI in Public Health & Real-World Data Analytics Real-world data sources (EHR, claims, surveillance systems); AI in outbreak prediction and population-level risk modelling; regression models in epidemiology; AI in vaccination forecasting; and case studies in epidemiological trend analysis (COVID-19 vaccine hesitancy, diabetes-prevalence and antibiotic-resistance forecasting).	6 h
Unit 5	Guided Project — Translational AI in Pharmacy Implementing a supervised ML model on real-world pharmacy data (formulation, pharmacokinetics, ADR detection, quality control, automation or public health), validating it, analysing regulatory implications, identifying ethical risks such as bias and privacy, and presenting a structured AI-implementation plan.	6 h

BP802T Clinical Pharmacotherapeutics 30 hours

Evidence-based drug therapy for common and chronic diseases; treatment guidelines; rational prescribing and patient management.

Unit 1	Cardiovascular System The definition, etiopathogenesis, clinical manifestations and overview of management of ischemic heart disease, hypertension, heart failure, myocardial infarction, hyperlipidaemia and arrhythmia.	5 h
Unit 2	Respiratory System The definition, etiopathogenesis, clinical manifestations and management of asthma and chronic obstructive pulmonary disease.	2 h
Unit 3	Renal System Acute renal failure and chronic renal failure — their etiopathogenesis, clinical features and management — together with renal replacement therapy.	3 h
Unit 4	Endocrine System The etiopathogenesis, clinical manifestations and pharmacotherapeutic management of diabetes mellitus and of thyroid disorders.	3 h
Unit 5	Nervous System The etiopathogenesis, clinical manifestations and management of epilepsy, stroke and parkinsonism.	5 h

Unit 6	Gastrointestinal System The etiopathogenesis, clinical features and management of peptic ulcer disease and gastro-oesophageal reflux disease.	2 h
Unit 7	Diseases of Bones and Joints The etiopathogenesis, clinical manifestations and pharmacotherapy of rheumatoid arthritis and osteoarthritis.	3 h
Unit 8	Infectious Diseases The etiopathogenesis, clinical presentation and treatment of tuberculosis, pneumonia, urinary-tract infection, malaria and HIV.	4 h
Unit 9	Haematological Diseases The classification, etiopathogenesis, clinical features and management of the anaemias.	3 h

BP803T Industrial Pharmacy and Facility Design

45 hours

Pharmaceutical manufacturing and plant design; production management; scale-up, quality systems and regulatory facility requirements.

Unit 1	Regulatory Guidelines for Formulation Development The regulatory guidelines governing formulation development; ICH Q8 and Quality by Design — the fundamental terminology, the process and the tools of optimization; and the application of QbD principles to pharmaceutical product development.	12 h
Unit 2	Stability Testing The ICH guidelines on stability testing; stability protocols, storage conditions and climatic zones; accelerated and long-term studies; and shelf-life determination and the assignment of expiry dates.	9 h
Unit 3	Industrial Aspects of Product Development The industrial aspects of product development; and pilot-plant and scale-up studies — the general considerations, the significance of scale-up, and the scale-up of solid, liquid and semisolid dosage forms.	9 h
Unit 4	Technology Development and Transfer Technology development and transfer; the WHO guidelines on technology transfer — terminology, the technology-transfer protocol and documentation; and the transfer of process and analytical methods between sites.	9 h
Unit 5	Technology Transfer Agencies and Facility Design The technology-transfer agencies operating in India — APCTD, NRDC, TIFAC, BCIL and TBSE/SIDBI; and pharmaceutical facility design, plant layout and the regulatory requirements governing manufacturing premises.	6 h

BP804T Pharmaceutical Management

30 hours

Principles of management; pharmaceutical marketing, finance and human resources; supply-chain and business management.

Unit 1	Introduction to Pharmaceutical Management An introduction to management and an overview of the Indian and global pharmaceutical industry; and the management functions of planning, organizing, leading and controlling, together with decision-making and time management.	6 h
Unit 2	Marketing Management in Pharmaceuticals The definition and uniqueness of pharmaceutical marketing; an overview of the global and Indian marketing scenario; the marketing mix and the four Ps — product, price, place and promotion; and strategic marketing.	6 h
Unit 3	Pharmaceutical Product Management Product-life-cycle management and new-product launch; branding, positioning and portfolio management; and the role of the product manager together with promotional strategy and the medical-representative function.	6 h
Unit 4	Financial and Human Resource Management The basics of financial management — budgeting, costing, break-even analysis and the interpretation of financial statements; and human-resource management including recruitment, training, motivation and performance appraisal.	6 h
Unit 5	Supply Chain and Inventory Management The pharmaceutical supply chain and distribution channels; inventory-management techniques including ABC and VED analysis, economic order quantity and safety stock; warehousing and cold-chain management; and logistics and procurement practice.	6 h

BP805T Sterile Dosage Forms and Novel Drug Delivery System

45 hours

Parenteral and sterile products; novel and targeted drug-delivery systems — controlled-release, transdermal and nanotechnology-based delivery.

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| Unit 1 | Fundamentals, Polymers and Materials for NDDS | 12 h |
| | The limitations of conventional dosage forms — solubility, permeability, toxicity and first-pass metabolism; the classification of novel drug-delivery systems (controlled-release, targeted, stimuli-responsive, chronotherapeutic, transdermal and mucosal, implantable and injectable depot, vesicular, polymeric, ocular, pulmonary and nasal); biodegradable and biocompatible polymers such as PLA, PLGA, PCL, chitosan and gelatin; lipids and surfactants including lecithin, phospholipids, Span/Tween and solid lipid nanoparticles; inorganic systems such as silica, gold nanoparticles, iron oxide and MOFs; and the excipients used in NDDS, GRAS substances, the IIG database and regulatory constraints. | |
| Unit 2 | Oral and Mucosal Delivery Systems | 6 h |
| | Gastro-retentive systems — floating, bioadhesive and expandable; colon-targeted systems that are pH-triggered, microbially triggered or time-dependent; buccal, nasal and pulmonary carriers including films, sprays, dry-powder inhalers and liposomes; and in vitro—in vivo correlation with biorelevant dissolution testing. | |
| Unit 3 | Transdermal and Long-Acting Systems | 6 h |
| | An introduction to transdermal drug delivery — the need for it, its advantages and disadvantages, basic structure and components, and formulation aspects including permeation enhancers; long-acting systems such as in-situ gels, microspheres, implants and ocular inserts; and transdermal and microneedle technologies including iontophoresis and sonophoresis. | |
| Unit 4 | Evaluation, Quality and Translation | 6 h |
| | Preformulation and Quality by Design — QTPP, critical quality attributes and critical process parameters; characterization methods including particle size, zeta potential, SEM/TEM, in-vitro release and permeability assays (PAMPA, Caco-2); non-clinical evaluation through PK/PD modelling, biodistribution and toxicology; regulatory pathways including 505(b)(2), complex generics, ICH Q8—Q10 and the EMA routes; nanosystems and precision medicine; and case studies such as liposomal amphotericin B, mRNA-lipid-nanoparticle vaccines and depot antipsychotic injections. | |
| Unit 5 | Sterile Dosage Forms — Parenteral and Ophthalmic | 14 h |
| | The introduction and classification of sterile products — small-volume versus large-volume parenterals, routes and their advantages and limitations; Water for Injection — types, preparation, storage and distribution and the pharmacopoeial requirements; formulation components including vehicles, buffers, co-solvents, surfactants, antioxidants, preservatives and chelators, with isotonicity and osmolality; manufacture by aseptic versus terminal sterilisation, filtration and lyophilisation with environmental controls; containers and closures — glass and plastic systems, elastomers, selection factors, evaluation and container—closure integrity, together with Form-Fill-Seal and Blow-Fill-Seal technology; and ophthalmics — solutions, suspensions, ointments, gels and inserts, the physiological factors of pH, tonicity and viscosity, residence-time enhancers and preservative-free systems. | |
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