ANDHRA KESARI UNIVERISITY, ONGOLE

B. PHARMACY

COMPLETE COURSE STRUCTURE AS PER R -26 Regulation

Effective from Academic Year 2026-27 Admitted Batch

I YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP101T	Basics of Python Programming for Pharmaceutical Sciences (Theory)	2	0	0	2	20	30	50
2	R26BP102T	General Pharmacy (Theory)	3	0	0	3	30	45	75
3	R26BP103T	Healthcare Psychology and Communication Skills (Theory)	1	0	0	1	20	30	50
4	R26BP104T	Human Anatomy, Physiology and Pathophysiology I (Theory)	4	0	0	4	40	60	**100**
5	R26BP105T	Introduction to Pharmacognosy (Theory)	3	0	0	3	30	45	75
6	R26BP106T	Pharmaceutical Inorganic and Analytical Chemistry (Theory)	3	0	0	3	30	45	75
7	R26BP107P	General Pharmacy (Practical)	0	0	3	1	20	30	50
8	R26BP108P	Healthcare Psychology and Communication Skills (Practical)	0	0	2	1	20	30	50
9	R26BP109P	Human Anatomy, Physiology and Pathophysiology I (Practical)	0	0	3	1	20	30	50
10	R26BP110P	Introduction to Pharmacognosy (Practical)	0	0	3	1	20	30	50
11	R26BP111P	Pharmaceutical Inorganic and Analytical Chemistry (Practical)	0	0	3	1	20	30	50
		Total	**16**	**0**	**14**	**21**	**270**	405	**675**

I YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP201T	Applied Biostatistics and Data Analytics for Pharmaceutical Sciences (Theory)	2	0	0	2	20	30	50
2	R26BP202T	Biochemistry (Theory)	3	0	0	3	30	45	75
3	R26BP203T	Human Anatomy, Physiology and Pathophysiology II (Theory)	4	0	0	4	40	60	100
4	R26BP204T	Pharmaceutical Organic Chemistry (Theory)	4	0	0	4	40	60	100
5	R26BP205T	Pharmacognosy and Phytochemistry (Theory)	4	0	0	4	40	60	100
6	R26BP206T	Physical Pharmaceutics (Theory)	3	0	0	3	30	45	75
7	R26BP207P	Biochemistry (Practical)	0	0	3	1	20	30	50
8	R26BP208P	Human Anatomy, Physiology and Pathophysiology II (Practical)	0	0	3	1	20	30	50
9	R26BP209P	Pharmaceutical Organic Chemistry (Practical)	0	0	3	1	20	30	50
10	R26BP210P	Pharmacognosy and Phytochemistry (Practical)	0	0	3	1	20	30	50
11	R26BP211P	Physical Pharmaceutics (Practical)	0	0	3	1	20	30	50
12	R26SE212P*	Communication Skills(Practical)	0	0	2	1	20	30	50
13	R26SE213P*	Mental Well-Being, Stress & Conflict Management(Practical)	0	0	2	1	20	30	50
14	R26SE214P*	Fundamentals of Computer Operations(Practical)	0	0	2	1	20	30	50
		Total	**20**	**0**	**17**	**26**	320	**480**	800

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II YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP301T	Introduction to Machine Learning in Pharmaceutical Sciences (Theory)	2	0	0	2	20	30	50
2	R26BP302T	Environmental Sciences (Theory)	1	0	0	1	20	30	50
3	R26BP303T	Ethics and Universal Human Values (Theory)	1	0	0	1	20	30	50
4	R26BP304T	General Pharmacology (Theory)	3	0	0	3	30	45	75
5	R26BP305T	Heterocyclic Compounds and Stereochemistry (Theory)	3	0	0	3	30	45	75
6	R26BP306T	Pharmaceutical Dosage Forms I (Theory)	3	0	0	3	30	45	75
7	R26BP307T	Pharmaceutical Engineering (Theory)	3	0	0	3	30	45	75
8	R26BP308T	Pharmaceutical Microbiology (Theory)	3	0	0	3	30	45	75
9	R26BP309P	General Pharmacology (Practical)	0	0	4	2	20	30	50
10	R26BP310P	Heterocyclic Compounds and Stereochemistry (Practical)	0	0	4	2	20	30	50
11	R26BP311P	Pharmaceutical Dosage Forms I (Practical)	0	0	3	1	20	30	50
12	R26AE312P*	Elective: 1. Nutraceuticals and Functional Foods(Practical)	0	0	2	1	20	30	50
13	R26AE313P*	Elective: 2. Food Analysis(Practical)	0	0	2	1	20	30	50
14	R26AE314P*	Elective: 3.Yoga and Life Sciences(Practical)	0	0	2	1	20	30	50
		Total	**19**	**0**	**13**	**25**	**290**	**435**	**725**

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

II YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP401T	Herbal Drug Technology (Theory)	3	0	0	3	30	45	75
2	R26BP402T	Medicinal Chemistry (Theory)	3	0	0	3	30	45	75
3	R26BP403T	Pharmaceutical Biotechnology (Theory)	3	0	0	3	30	45	75
4	R26BP404T	Social Pharmacy and Public Health (Theory)	2	0	0	2	20	30	50
5	R26BP405T	Systemic Pharmacology I (Theory)	3	0	0	3	30	45	75
6	R26BP406P	Herbal Drug Technology (Practical)	0	0	3	1	20	30	50
7	R26BP407P	Medicinal Chemistry (Practical)	0	0	3	1	20	30	50
8	R26BP408P	Pharmaceutical Biotechnology (Practical)	0	0	3	1	20	30	50
9	R26BP409P	Social Pharmacy and Public Health (Practical)	0	0	2	1	20	30	50
10	R26BP410P	Systemic Pharmacology I (Practical)	0	0	3	1	20	30	50
11	R26BP411I	Internship (Mandatory)	0	0	8	4	100	0	100
		Total	**14**	**0**	**22**	**23**	**340**	**360**	**700**

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III YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP501T	Biomedicinal Chemistry (Theory)	3	0	0	3	30	45	75
2	R26BP502T	Industrial Pharmacognosy (Theory)	3	0	0	3	30	45	75
3	R26BP503T	Innovation and Startup Ecosystem (Theory)	2	0	0	2	20	30	50
4	R26BP504T	Pharmaceutical Dosage Form II (Theory)	2	0	0	2	20	30	50
5	R26BP505T	Pharmaceutical Quality Assurance (Theory)	3	0	0	3	30	45	75
6	R26BP506T	Systemic Pharmacology II (Theory)	3	0	0	3	30	45	75
7	R26BP507P	Biomedicinal Chemistry (Practical)	0	0	4	2	20	30	50
8	R26BP508P	Industrial Pharmacognosy (Practical)	0	0	3	1	20	30	50
9	R26BP509P	Pharmaceutical Dosage Form II (Practical)	0	0	3	1	20	30	50
10	R26BP510P	Systemic Pharmacology II (Practical)	0	0	4	2	20	30	50
		Total	**16**	**0**	**14**	**22**	**240**	**360**	**600**

III YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP601T	Advanced Pharmacognosy (Theory)	3	0	0	3	30	45	75
2	R26BP602T	Biopharmaceutics and Pharmacokinetics (Theory)	3	0	0	3	30	45	75
3	R26BP603T	Intellectual Property Rights (Theory)	2	0	0	2	20	30	50
4	R26BP604T	AI applications in Pharmaceutical Sciences (Theory)	2	0	0	2	20	30	50
5	R26BP605T	Pharmaceutical Analysis (Theory)	3	0	0	3	30	45	75
6	R26BP606T	Pharmaceutical Jurisprudence (Theory)	3	0	0	3	30	45	75
7	R26AE607T*	Green Chemistry	1	0	0	1	20	30	50
8	R26AE608T*	Materiovigilance and Hemovigilance							
9	R26AE609T*	Scientific Writing;							
10	R26AE610T*	Drug Store and Business Management;							
11	R26AE611T*	Career Building in Cultivation of . . Medicinal Plants							
12	R26AE612T*	Active Pharmaceutical Ingredients and Excipient Sciences							
13	R26BP613P	Biopharmaceutics and Pharmacokinetics (Practical)	0	0	3	1	20	30	50
14	R26BP614P	Pharmaceutical Analysis (Practical)	0	0	4	2	20	30	50
15	R26SE615P*	Computer-Aided Drug Design	0	0	2	1	20	30	50
16	R26SE616P*	Analytical Method Development and Validation							
17	R26SE617P*	Principles of Preclinical Studies							
18	R26VA618P*	Professional Skills;	0	0	2	1	20	30	50
19	R26VA619P*	Process Analytical Technology (PAT) and QbD in Formulation Science							
20	R26BP620P	Internship (Mandatory)	0	0	8	4	100	0	100
		Total	**17**	**0**	**19**	**26**	**360**	**390**	**750**

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

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IV YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP701T	Biostatistics and Research Methodology (Theory)	3	0	0	3	30	45	75
2	R26BP702T	Cosmetics and Cosmeceuticals (Theory)	2	0	0	2	20	30	50
3	R26BP703T	AI in Clinical Applications (Theory)	2	0	0	2	20	30	50
4	R26BP704T	Modern Analytical Techniques (Theory)	3	0	0	3	30	45	75
5	R26BP705T	Pharmacovigilance (Theory)	3	0	0	3	30	45	75
6	R26BP706T	Pharmacy Practice (Theory)	3	0	0	3	30	45	75
7	R26BP707T	Regulatory Affairs (Theory)	2	0	0	2	20	30	50
8	R26AE708T*	Current Good Manufacturing Practices (cGMP)	1	0	0	1	20	30	50
9	R26AE709T*	Pharmaceutical Automation							
10	R26AE710T*	Modern Techniques in Cellular Biology							
11	R26AE711T*	Medical Devices							
12	R26AE712T*	Transformation of Food Waste into Medicinal Products							
13	R26AE713T*	Biosimilars, Vaccines & Macromolecules							
14	R26BP714P	Modern Analytical Techniques (Practical)	0	0	3	1	20	30	50
15	R26RP715	Research Project	0	0	0	6	150	0	150
		Total	**19**	**0**	**3**	**26**	**370**	**330**	**700**

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

IV YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits	Internal	External	Total
1	R26BP801T	Ethical Considerations and Translational Applications of AI in Pharmacy (Theory)	2	0	0	2	20	30	50
2	R26BP802T	Clinical Pharmacotherapeutics (Theory)	2	0	0	2	20	30	50
3	R26BP803T	Industrial Pharmacy and Facility Design (Theory)	3	0	0	3	30	45	75
4	R26BP804T	Pharmaceutical Management (Theory)	2	0	0	2	20	30	50
5	R26BP805T	Sterile Dosage Forms and Novel Drug Delivery System (Theory)	3	0	0	3	30	45	75
6	R26AE806T*	Pharmaceutical Packaging	2	0	0	2	20	30	50
7	R26AE807T*	Supply Chain Management							
8	R26AE808T*	Industrial Safety and Waste Management							
9	R26AE809T*	Traditional Healing Practices of India							
10	R26AE810T*	Futuristic Pharma through AR/VR: Pharma 4.0							
11	R26AE811T*	Herbal Cosmetics for Industry Perspective							
12	R26BP812P	Pharmaceutical Marketing Skills (Practical)	0	0	2	1	20	30	50
13	R26BP813P	Sterile Dosage Forms and Novel Drug Delivery System (Practical)	0	0	4	2	20	30	50
	R26VA814P*	Cleaning Validation	0	0	2	1	20	30	50
	R26VA815P*	Basic Training in Aseptic Handling Techniques							
	R26VA816P*	Impurity Profiling							
15	R26RP817	Research Project	0	0	0	6	150	0	150
		Total	**14**	**0**	**8**	**24**	**350**	**300**	**650**

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

Semester III

Course Code	Name of the course		No. of hours per week (L/P)	Credit points
BP301T	Introduction to Machine Learning in Pharmaceutical Sciences (Theory)		2	2
BP302T	Environmental Sciences (Theory)		1	1
BP303T	Ethics and Universal Human Values (Theory)		1	1
BP304T	General Pharmacology (Theory)		3	3
BP305T	Heterocyclic Compounds and Stereochemistry (Theory)		3	3
BP306T	Pharmaceutical Dosage Forms I (Theory)		3	3
BP307T	Pharmaceutical Engineering (Theory)		3	3
BP308T	Pharmaceutical Microbiology (Theory)		3	3
BP309P	General Pharmacology (Practical)		4	2
BP310P	Heterocyclic Compounds and Stereochemistry (Practical)		4	2
BP311P	Pharmaceutical Dosage Forms I (Practical)		3	1
BP312P AEC*	BP312P AEC1	Nutraceuticals and Functional Foods	2	1
	BP312P AEC2	Food Analysis		
	BP312P AEC3	Yoga and Life Sciences		
Total			**32**	**25**

* Only 1 elective course shall be selected

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

Course Code	Course Title			Course Type
BP301T	**Introduction to Machine Learning in Pharmaceutical Sciences (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
2	2	--	--	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce the fundamental concepts of Artificial Intelligence, Machine Learning, and Data Science and their relevance to pharmaceutical sciences.
2. Develop conceptual understanding of machine learning workflows, including model building, training–testing strategies, and evaluation.
3. Explain the principles and applications of regression models for predicting continuous outcomes in pharmaceutical and healthcare data.
4. Familiarize students with classification and tree-based models used for clinical prediction and decision-making.
5. Introduce unsupervised learning techniques and demonstrate their applications in pattern recognition and healthcare data analysis.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the basic concepts of artificial intelligence and machine learning, including types of learning and model development.
2	Apply regression models to analyze pharmaceutical data and interpret model outputs and performance metrics.
3	Analyze classification models for predicting categorical clinical outcomes using evaluation measures such as accuracy, sensitivity, and ROC–AUC.
4	Interpret tree-based and ensemble learning models for decision-making in pharmaceutical and healthcare applications.
5	Utilize unsupervised learning techniques such as clustering to identify patterns in healthcare and pharmaceutical datasets.

Detailed Syllabus:-

Unit No.	Topics	No. of Lectures
I	**Foundations of Machine Learning** Definition and scope of Artificial Intelligence, Machine Learning, and Data Science • Types of machine learning: supervised, unsupervised, and reinforcement learning • Features and labels, training data and testing data • Concept of model building and prediction • Train-test split, overfitting and underfitting • Conceptual explanation of bias-variance trade-off • Overview of the basic ML workflow	6 Hours
II	**Regression Models in Healthcare** Overview of the concepts in predictive modeling for continuous outcomes, with emphasis on interpretation of outputs, and applications in pharmaceutical sciences. • Linear regression and multiple linear regression • Model coefficients and their interpretation • Residuals and goodness-of-fit • Performance metrics such as Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R^2 score • Implementation of regression models on pharmaceutical data (e.g. dose–response relationships, predicting drug dissolution rates, estimating PK parameters), and demonstration of predictive modeling using python libraries such as sklearn	6 Hours
III	**Classification Models in Clinical Applications** Overview of the following ML models used for categorical prediction, with emphasis on conceptual understanding, interpretation of outputs and applications in pharmaceutical sciences. • Logistic regression • Probability output and threshold selection • Confusion matrix • Accuracy, sensitivity, specificity, precision, recall • Intuitive understanding of ROC curve and AUC, and k-Nearest Neighbors • Demonstration of predictive modeling using pharmaceutical and clinical examples such as predicting adverse drug reactions, disease risk prediction, binary therapeutic outcome modeling.	6 Hours

IV	**Tree-Based Models & Ensemble Learning** Overview of the following ML models with emphasis on intuitive and conceptual understanding. • Decision Trees (structure and splitting criteria), interpretation of decision paths and feature importance • Random Forest, overview of ensemble concept • Advantages and limitations of tree-based models • Demonstration of these models for pharmaceutical and clinical applications such as ADR risk stratification, Patient classification, Predicting treatment outcomes etc.	6 hours
V	**Unsupervised Learning & Practical Case Studies** Overview of the unsupervised learning with emphasis on intuitive and conceptual understanding of pattern recognition and clustering, and their applications in pharmaceutical sciences. • Concept of unsupervised learning • Clustering overview, K-means clustering, choosing number of clusters, Interpreting cluster outputs • Mini-case study integrating regression, classification, or clustering on healthcare datasets to demonstrate Patient segmentation, and drug grouping based on properties.	6 Hours

Recommended References *(Preferably latest editions)*:

1. James, G., Witten, D., Hastie, T. and Tibshirani, R. *An Introduction to Statistical Learning with Applications in Python.* Springer. Available at: statlearning.com.

2. Simon, G. J. and Aliferis, C. *Artificial Intelligence and Machine Learning in Health Care and Medical Sciences: Best Practices and Pitfalls.* Springer.

3. Brown, N. *Artificial Intelligence in Drug Discovery.* Royal Society of Chemistry.

4. Walters, S. J., Campbell, M. J. and Machin, D. *Medical Statistics: A Textbook for the Health Sciences.* Wiley-Blackwell.

5. Géron, A. *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow.* O'Reilly Media.

Course Code	Course Title			Course Type
BP302T	**Environmental Sciences (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	1	--	--	15
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Explain the environmental challenges and disaster risks relevant to human health and pharmaceutical activities.
2. Demonstrate knowledge of waste management protocols and legal guidelines for pharmaceutical and biomedical waste handling.
3. Apply technical understanding of effluent and sewage treatment technologies used in the pharmaceutical sector.
4. Assess the ecological impact of APIs and recommend mitigation strategies for pollution control.
5. Explain sustainable practices and energy-efficient operations within pharmaceutical industries.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Understand the basic concepts of environmental pollution, its types, causes, and disaster management strategies.
2	Identify and categorize different types of pharmaceutical and biomedical waste generated in the healthcare and pharmaceutical sectors.
3	Describe the design and operation of Effluent Treatment Plants (ETPs), Sewage Treatment Plants (STPs), and water purification systems in pharma settings.
4	Analyze the environmental risks posed by pharmaceutical manufacturing, APIs, and dosage forms.
5	Recognize the importance of sustainability and green pharmacy practices in the pharmaceutical industry.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Environmental Pollution** • Definition, scope, and importance of environmental studies • Types, causes, effects, and control measures of Air, water, soil, noise, and nuclear pollution • Solid waste and hazardous waste management in pharmaceuticals • Role of pharmacists in conservation and sustainable use of resources	3 Hours
II	**Pharmaceutical Waste and Effluent Management** • Types of pharmaceutical waste: chemical, expired drugs, packaging, biomedical waste • Biomedical Waste Management Rules (2016) and CPCB guidelines • Effluent Treatment Plant (ETP) design and functioning • Water purification methods in pharmaceutical settings (RO, UV, distillation, filtration)	3 Hours
III	**Environmental Impact of the Pharmaceutical Industry** • Sources of pollution in pharmaceutical manufacturing • Types of pharmaceutical waste: solid, liquid, and gaseous • Environmental risks of active pharmaceutical ingredients (APIs) and its dosage forms. Impact of pharmaceutical residues on ecosystems and human health	3 Hours
IV	**Sustainability in the Pharmaceutical Sector** • Principles of sustainable development in pharma • Principles and Practices of Green pharmacy • Energy conservation and resource optimization.	3 Hours
V	**Government Policies, Compliance, and Practical Exposure** • Environmental laws: o Environment (Protection) Act, 1986 o Water (Prevention and Control of Pollution) Act • National Green Tribunal (NGT) and regulatory bodies (CPCB, SPCB) • Government initiatives: o Swachh Bharat Abhiyan o River rejuvenation program- Namami Gange Programme o Jal Jeevan Mission • ISO-14000	3 Hours
Recommended References *(Preferably latest editions)*: 1. Bharucha, E. *Environmental Studies.* University Grants Commission, New Delhi. 2. Rajagopalan, R. *Environmental Studies.* Oxford University Press. 3. Joseph, B. *Environmental Studies.* Tata McGraw Hill.		

Course Code	Course Title		Course Type	
BP303T	**Ethics and Universal Human Values (Theory)**		Core	
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
1	1	--	--	15
Maximum Marks	SE		ESE	
50	20		30	

COURSE OBJECTIVES:

The objectives of this course are:

1. Understand the concept, definition, scope, and need of Value Education in personal, social, and professional life.
2. Develop self-exploration, positive attitude, confidence, and ethical sensitivity as foundations of value-based living.
3. Comprehend the co-existence of Self (I) and Body and establish harmony between physical and psychological aspects.
4. Analyze the importance of family, society, and relationships in promoting mutual respect, trust, and cooperation.
5. Appreciate the concept of harmony in nature and existence, leading to sustainable and responsible human conduct.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the principles, content, and process of Value Education and apply ethical values in day-to-day life.
2	Demonstrate self-awareness, right understanding, confidence, and clarity about happiness and prosperity through self-exploration.
3	Distinguish between the needs and activities of the Self and the Body and establish harmony between them.
4	Apply values such as respect, affection, kindness, gratitude, and love to maintain harmony in family and society.
5	Interpret the concept of harmony in nature and holistic existence, recognizing the four orders of nature and the comprehensive human goal.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Introduction to Value Education** 1. Concept, definition, and need for value education. 2. Content and process of value education. 3. Application of human values in everyday life.	3 Hours

II	**Self-Exploration and Human Aspirations** 1. Self-exploration as a means of value education. 2. Development of positive attitude and self-confidence. 3. Right understanding of happiness and prosperity.	3 Hours
III	**Harmony in the Human Being** 1. Human being as more than just the physical body. 2. Harmony between the Self ('I') and the Body. 3. Understanding the coexistence of the Self and the Body.	3 Hours
IV	**Harmony in the Individual and Society** 1. Understanding the needs of the Self and the needs of the Body. 2. Activities of the Self and activities of the Body. 3. Family as the basic unit of human interaction and the role of values in relationships. 4. Foundations of respect in relationships: affection, kindness, guidance, reverence, glory, gratitude, and love.	3 Hours
V	**Harmony in Society and Nature** 1. Comprehensive human goal: the five dimensions of human endeavour. 2. Harmony in nature and the four orders in nature. 3. Holistic perception of harmony in existence.	3 Hours

Recommended References *(Preferably latest editions)*:

1. Tripathi, A. N. *Human Values.* New Age International Publishers, New Delhi.
2. Gaur, R. R., Asthana, R. and Bagaria, G. P. *A Foundation Course in Human Values and Professional Ethics.* Excel Books, New Delhi.
3. Gaur, R. R., Asthana, R. and Bagaria, G. P. *Teachers' Manual for A Foundation Course in Human Values and Professional Ethics.* Excel Books, New Delhi.
4. Raghavan, V. *Universal Human Values.* Excel Books.
5. Gaur, R. R., Sangal, R. and Bagaria, G. P. *Human Values and Professional Ethics.* Excel Books.
6. Govindarajan, M., Natarajan, S. and Senthil Kumar, V. S. *Engineering Ethics.* Prentice Hall India.
7. Velasquez, M. G. *Business Ethics: Concepts and Cases.* Pearson Education.

Course Code	Course Title			Course Type
BP304T	**General Pharmacology (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are:

1. To provide a foundational understanding of the history of pharmacology, focusing on the evolution of drug discovery and development.
2. Introducing the concepts of pharmacodynamics and pharmacokinetics, helping students understand the mechanisms of drug action, absorption, distribution, metabolism, and excretion.
3. To familiarize students with the principles behind new drug development, including preclinical testing, drug screening methods, and safety pharmacology.
4. To enable students to learn about toxicity testing, ensuring they understand different methods of evaluating drug safety and the regulatory guidelines involved in toxicity assessment.
5. To prepare students for understanding the pharmacology of different therapeutic drug classes, by applying basic pharmacological knowledge to current trends in drug development and screening.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Relate the fundamental principles of pharmacodynamics and pharmacokinetics of drugs actions on the human body.
2	Illustrate the processes involved in the drug metabolism, toxicity, and safety evaluation to relate their significance in the preclinical development of new drugs.
3	Apply the knowledge of pharmacological principles to efficacy, toxicity, and safety evaluation of new drug candidates.
4	Assess the ethical and scientific principles underlying drug safety, efficacy, and toxicity testing
5	Appraise the recent trends in pharmacology.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Introduction to Pharmacology** **a)** Definition, historical perspectives, branches of pharmacology and their scope, drug, nature and sources of drugs, International Classification of Diseases (ICD) and International Non-proprietary Names (INN) for drugs **b)** Concept of generic medicines, essential drugs and rational drug use (RDU). Indian Government's initiatives to promote these concepts. **c)** Routes of drug administration along with their advantages and disadvantages.	08 Hours
II	**Pharmacokinetics** **a)** Drug absorption, mechanisms of drug absorption, membrane transporters, bioavailability, bioequivalence, factors affecting drug absorption. **b)** Drug distribution in different compartments, volume of distribution, storage sites, plasma protein binding and its therapeutic importance. **c)** Drug biotransformation, microsomal, non- microsomal metabolism and cytochrome P450 enzyme system, phase I and II reactions, first-pass metabolism, entero-hepatic cycling, concept of prodrugs. **d)** Drug excretion and its kinetics.	07 Hours
III	**Pharmacodynamics** **a)** Types drug action and mechanisms of drug action, dose response relationship. **b)** Receptor theories, structure of receptors, classification and regulation of receptors, spare receptors. Concept of agonist, inverse agonist, partial agonist and antagonist. **c)** Signal transduction mechanisms of receptors. **d)** Factors modifying drug action including the concepts of tachyphylaxis, idiosyncrasy, drug tolerance, dependence, addiction, and the combined effect of drugs (Additive effect & Synergism). **e)** Adverse drug reactions (ADR) and types of ADRs. **f)** Drug interaction, types, pharmacokinetic and pharmacodynamic drug-drug interactions.	10 Hours
IV	**Overview of drug discovery and evaluation of new drug** **a)** Brief discussion on drug discovery and preclinical evaluation of new drugs. **b)** Human relevant screening techniques: Reconstructed human epidermis, organ-on- Chip model, skin irritancy test by reconstructed corneal epithelium, skin corrosivity testing by Direct	12 Hours

	Peptide Reactivity Assay. **c)** Advantages and disadvantages of *in vitro* and *in silico* Pharmacological screening and evaluation **Recent trends in pharmacology** **a)** Chronopharmacology: Introduction, biological clock, types of rhythms, hormones, diseases and drugs affected by circadian rhythm. Introduction to chrono kinetics and importance of chronotherapeutic and future scope. **b)** Introduction, general principles, applications and scope of Pharmacogenomics, Gene therapy, Biosimilars and Precision medicine.	
V	**Toxicology** **a)** Introduction to toxicology and its branches. Classification of poisons based on actions and lethal doses, types of antidotes. **b)** General principles of treatment of acute poisoning include heavy metal poisoning. Management of poisoning. **c)** Definition and basic knowledge of preclinical toxicity testing-acute toxicity, sub-acute toxicity, combined chronic and carcinogenicity testing as per OECD norms. **d)** Basic understanding of principles of genotoxicity and teratogenicity as per OECD guidelines. **e)** Definition and concepts of safety pharmacology as per ICH and OECD guidelines.	8 Hours

Recommended References *(Preferably latest editions)*:

1. Brunton, L., Hilal-Dandan, R. and Knollmann, B. *Goodman and Gilman's The Pharmacological Basis of Therapeutics.* McGraw-Hill Education.
2. Rang, H. P., Dale, M. M., Ritter, J. M., Flower, R. J. and Henderson, G. *Rang and Dale's Pharmacology.* Elsevier.
3. Katzung, B. G. and Trevor, A. J. *Basic and Clinical Pharmacology.* McGraw-Hill Education.
4. Whalen, K. and Finkel, R. *Lippincott's Illustrated Reviews: Pharmacology.* Wolters Kluwer.
5. Tripathi, K. D. *Essentials of Medical Pharmacology.* Jaypee Brothers Medical Publishers.

Course Code	Course Title			Course Type
BP305T	**Heterocyclic Compounds and Stereo Chemistry (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
3	3	--	--	45
Maximum Marks	SE		ESE	
75	30		45	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand Chemistry of Carboxylic acids, Phenols, Amines and Polynuclear Aromatic hydrocarbons
2. Explain the concepts of optical isomerism and their pharmaceutical significance.
3. Explain the concepts of Geometrical isomerism and their pharmaceutical significance
4. Know about IUPAC nomenclature and Chemistry of heterocycles
5. Equip students with knowledge of organic reaction mechanisms and their applications in drug synthesis.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Recall and outline methods for the preparation and chemical reactions of various organic compounds.
2	Explain the acidity and basicity of organic compounds and recognize the medicinal relevance of polynuclear hydrocarbons and heterocyclic compounds.
3	Illustrate the concepts of stereoisomerism with appropriate examples.
4	Classify, name, and interpret the structures and chemistry of heterocyclic compounds.
5	Describe and analyze the synthesis, chemical behaviour, and applications of heterocyclic and polynuclear hydrocarbon compounds.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Chemistry of Carboxylic acids, Phenols, Amines and Polynuclear Aromatic hydrocarbons** 1. **Aliphatic and aromatic carboxylic acids** • Methods to prepare carboxylic acids (Oxidation of alcohols, carbonation of Grignard reagent, Kolbe-Schmidt reaction) • Study of acidity of carboxylic acids and effect of substituents on acidity • Study of chemical reactions of carboxylic acids [Mechanism of nucleophilic acyl substitution, Decarboxylation and Hell-Volhard-Zelinsky reaction]. Pharmaceutical applications of aromatic carboxylic acids (Benzoic acid, Salicylic acid, Acetyl Salicylic acid) 2. **Aliphatic and aromatic amines** • Methods to prepare amines (Reduction of nitro compound, reduction of nitriles and Hofmann degradation of amides) • Study of basicity of amines and effect of substituents on basicity • Study of mechanism a n d synthetic applications of diazonium salts including Sandmeyer's and azo-dye coupling reaction 3. **Alcohols and Phenols** • Classification of alcohols, methods to prepare alcohols (oxymercuration - demercuration, reduction of carbonyl compounds) • Acidity of alcohols and Phenols including effect of substituent on acidity • Definition of phenols, method to prepare phenols by cumene process. Comparison of the acidity of phenol vs alcohol • Study of mechanism of chemical reactions of phenols (Reimer-Tiemann reaction, halogenation and nitration of phenols). Pharmaceutical applications of alcohols and phenols (Glycerine, Thymol, Paracetamol) 4. **Chemistry of polynuclear hydrocarbons** Definition, and classification of polynuclear aromatic hydrocarbons, Study of synthesis (Haworth synthesis) and mechanism of electrophilic aromatic substitution reactions of naphthalene, phenanthrene and anthracene and medicinal uses of drugs containing Naphthalene (Propranolol, Naphazoline) and Phenanthrene (Morphine, Codeine).	15 Hours
II	**Optical isomerism** • Definition of stereoisomerism and types of stereoisomerism with examples • Definition with examples for optical activity, origin of chirality, elements of symmetry, chiral and achiral molecules, enantiomerism, diastereoisomerism and meso compounds • Study of configuration including D & L system, sequence rules, R & S system. Medicinal importance of optical isomers with examples • Racemic mixture and resolution of racemic mixtures	7 Hours

III	**Geometrical isomerism** • Nomenclature of geometrical isomers (Cis & Trans, E & Z, Syn & Anti system) • Conformational isomerism and its analysis in ethane, butane and cyclohexane • Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity in biphenyl compounds	6 Hours
IV	**Chemistry of five membered heterocycles** • IUPAC nomenclature and classification of heterocyclic compounds as per the Hansch- Widman system • Relative aromaticity and reactivity of pyrrole, furan and thiophene • Study of synthesis of pyrrole (Paal – Knorr synthesis), furan (Feist-Bénary reaction), thiophene (Hinsberg synthesis) and Mechanism of Electrophilic substitution reactions of pyrrole, furan and thiophene • Medicinal uses of drugs containing pyrrole (Ethosuximide, procyclidine), furan (Furosemide, Nitrofurazone) and thiophene (Cephaloridine, Clopidogrel)	10 Hours
V	**Chemistry of other heterocycles** • Study of nomenclature of fused heterocyclic compounds, synthesis for pyrazole (Knorr synthesis), imidazole (Debus-Radziszewski reaction), pyridine (The Hantzsch synthesis), quinoline (The Skraup synthesis) and Electrophilic aromatic substitution reactions of pyrazole and imidazole • Chemical structures of Indole, pyrimidine, benzimidazole, purine, azepine, pyrazole, oxazole, Phenothiazine, benzotriazole, quinoxaline • Basicity of imidazole, pyridine and quinolone • Medicinal uses of any two drugs containing pyrazole (Sildenafil, Celecoxib), imidazole (Metronidazole, Pilocarpine), pyridine (Isoniazid, Chlorpheniramine), quinoline (Chloroquine, Ciprofloxacin), indole (Indomethacin, Reserpine), benzimidazole (Albendazole, Mebendazole) pyrimidine (Fluorouracil, Sulphadiazine), purine (Mercaptopurine, Thioguanine), azepine (Diazepam, Loxapine) heterocycles	07 Hours

Recommended References *(Preferably latest editions)*:

1. Finar, I. L. *Organic Chemistry, Vol. 1.* Pearson Education.
2. Finar, I. L. *Organic Chemistry: Stereochemistry and Natural Products, Vol. 2.* Pearson Education.
3. Smith, M. B. and March, J. *March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure.* Wiley.
4. Bahl, B. S. and Bahl, A. *Textbook of Organic Chemistry.* S. Chand.
5. Nadendla, R. R. *Pharmaceutical Organic Chemistry: Heterocyclic and Natural Products.* Vallabh Prakashan.
6. Gilchrist, T. L. *Heterocyclic Chemistry.* Prentice Hall.
7. Eliel, E. L. and Wilen, S. H. *Stereochemistry of Organic Compounds.* Wiley.

Course Code	Course Title		Course Type	
BP306T	**Pharmaceutical Dosage Forms I (Theory)**		Core	
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
3	3	--	--	45
Maximum Marks	SE		ESE	
75	30		45	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the fundamentals of dosage form development, including pre-formulation studies, drug–excipient compatibility, and stability considerations as per ICH guidelines.
2. Acquire knowledge of formulation and manufacturing of compressed solid dosage forms, including tablets and coated tablets, along with quality control and packaging.
3. Develop competence in the formulation and evaluation of finely divided and filled solid dosage forms, such as powders, granules, and hard and soft gelatin capsules.
4. Understand the principles and formulation strategies of modified-release solid dosage forms, including sustained-release and controlled-release systems.
5. Gain knowledge of microencapsulation techniques, their applications, advantages, limitations, and evaluation of microcapsules in pharmaceutical products.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Describe pre-formulation principles and evaluate key physicochemical parameters critical to solid dosage-form development.
2	Apply formulation and manufacturing processes and perform quality control tests for tablets, including coated tablets, and troubleshoot common formulation and processing defects.
3	Formulate and evaluate finely divided and filled solid dosage forms such as medicated powders, granules, hard capsules, and soft gelatin capsules using appropriate materials, equipment, and quality control procedures.
4	Design and evaluate modified-release solid dosage forms by selecting suitable polymers and mechanisms to achieve sustained and controlled drug release.
5	Analyze various microencapsulation methods, select suitable techniques for specific drug-delivery needs, and evaluate microcapsules based on physicochemical and performance parameters.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Fundamentals of Dosage Form Development:** Pre-formulation studies: concept, need, and parameters including solubility, pKa, physical nature (amorphous and crystalline), polymorphism, particle size and shape, and powder flow parameters. Drug–excipient compatibility studies. Packaging selection for various dosage forms. Drug product and container-closure interaction. Introduction to stability guidelines of new drug substances and products (ICH Q1).	07 Hours
II	**Compressed Solids:** **Tablets** Excipients (roles and examples); tooling (types and specifications); manufacturing methods and equipment; tablet defects and remedies; in-process quality control (IPQC); finished-product tests; packaging. **Tablet Coating** Types of coating (sugar, film, compression, enteric); need, advantages, and limitations; polymers, process specifications, and equipment; coating defects; quality control of coated tablets.	12 Hours
III	**Finely Divided and Filled Solids:** Medicated powders and granules: formulation considerations, manufacturing processes (mixing, granulation), quality control, and packaging. Gelatin and non-gelatin shells: composition, empty shell manufacturing, quality control, and capsule sizes. Hard gelatin capsules: formulation design; filling methods (manual, semi-automatic, automatic); IPQC and finished-product tests; packaging. Soft gelatin capsules: shell composition and plasticizers; fill materials; manufacturing methods (rotary die and others); defects; quality control and stability.	12 Hours
IV	**Modified-Release Solids:** Types of tablets: sustained-release and controlled-release tablets. Concept, need, advantages, and disadvantages. Formulation design and drug-release mechanisms. Polymers used for sustained and controlled release. Evaluation of modified-release dosage forms.	07 Hours
V	**Microencapsulation:** Concept, need, advantages, and disadvantages. Methods of microencapsulation: spray drying, spray congealing, extrusion and spheronisation, fluidized bed coating, and phase-separation coacervation. Evaluation of microcapsules.	07 Hours

Recommended References *(Preferably latest editions)*:

1. Allen, L. V., Popovich, N. G. and Ansel, H. C. *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems.* Lippincott Williams & Wilkins.
2. Aulton, M. E. and Taylor, K. M. G. *Aulton's Pharmaceutics: The Design and Manufacture of Medicines.* Elsevier.
3. Lachman, L., Lieberman, H. A. and Kanig, J. L. *The Theory and Practice of Industrial Pharmacy.* CBS Publishers & Distributors.
4. Troy, D. B. and Beringer, P. *Remington: The Science and Practice of Pharmacy.* Pharmaceutical Press.
5. Robinson, J. R. and Lee, V. H. L. *Controlled Drug Delivery: Fundamentals and Applications.* CRC Press.
6. Sinko, P. J. *Martin's Physical Pharmacy and Pharmaceutical Sciences.* Lippincott Williams & Wilkins.
7. *Indian Pharmacopoeia.* Indian Pharmacopoeia Commission.
8. *United States Pharmacopeia.* United States Pharmacopeial Convention.
9. *British Pharmacopoeia.* British Pharmacopoeia Commission.

Course Code	Course Title		Course Type	
BP307T	**Pharmaceutical Engineering (Theory)**		Core	
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
3	3	--	--	45
Maximum Marks	SE		ESE	
75	30		45	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Provide fundamental knowledge of pharmaceutical engineering principles and common unit operations involved in solid and liquid pharmaceutical manufacturing.
2. Develop an understanding of thermal operations such as drying, evaporation, distillation, and heat transfer used in pharmaceutical processing.
3. Introduce material handling systems, corrosion control, and waste management practices relevant to pharmaceutical plants.
4. Explain the principles of fluid flow and flow measurement used in pharmaceutical process equipment.
5. Develop knowledge of the design, construction, working principles, and pharmaceutical applications of engineering equipment used in the pharmaceutical industry.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the principles and pharmaceutical applications of unit operations such as size reduction, mixing, size separation, and fluid flow.
2	Identify and describe the construction, working, and utility of various pharmaceutical engineering equipment.
3	Compare and evaluate different thermal processes such as drying, evaporation, distillation, and heat transfer based on operational efficiency.
4	Apply principles of safe and efficient material handling and understand the impact of corrosion and waste management in pharmaceutical industries.
5	Examine the relevance of contemporary technological trends such as PAT and automation for enhancing pharmaceutical manufacturing processes.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Unit operations associated with solids** Principle, construction, working, advantages and disadvantages and Pharmaceutical applications of size reduction, size separation and mixing equipment	12 Hours
II	**Unit operations associated with liquids** Principle, construction, working, advantages and disadvantages and Pharmaceutical applications of filtration, crystallization and centrifugation equipment	12 Hours
III	**Unit operations associated with heat transfer** Principle, construction, working, advantages and disadvantages and Pharmaceutical applications of evaporation, drying, distillation and Heat transfer equipment	12 Hours
IV	**Materials and material handling** Introduction to material handling equipment and techniques, Conveyors, hoists, and automated guided vehicles (AGVs), Storage systems: bins, silos in warehouses, Safety considerations in material handling and waste management. Types of corrosion and their impact on pharmaceutical processes and environment	05 Hours
V	**Flow of fluids** Types and measurement of flow**,** manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Orifice meter, Venturimeter, Pitot tube and Rotometer.	04 Hours

Recommended References (Preferably latest editions):

1. Banker, G. S. *Pharmaceutical Engineering.* Marcel Dekker.
2. Sambamurthy, K. *Introduction to Pharmaceutical Engineering.* New Age International.
3. Kennedy, T. F. *Good Design Practices for GMP Pharmaceutical Facilities.* CRC Press.
4. Banker, G. S. and Rhodes, C. T. *Modern Pharmaceutics.* CRC Press.
5. Hickey, A. J. *Pharmaceutical Process Engineering.* CRC Press.
6. Cole, G. C. *Pharmaceutical Facilities: Design, Layouts and Validation.* CRC Press.
7. Bertch, F. J. *Fundamentals of Modern Pharmaceutical Process Engineering.* Academic Press.
8. Chase, A. G. *Environmental Management in the Pharmaceutical Industry.* Springer.
9. Bunn, G. *Pharmaceutical Production Facilities: Design and Applications.* CRC Press.

Course Code	Course Title			Course Type
BP308T	**Pharmaceutical Microbiology (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce the fundamental concepts of microbiology and its relevance to pharmaceutical sciences.
2. Provide insights into the industrial application of microorganisms in the manufacture of pharmaceutical products.
3. Provide knowledge Good Manufacturing Practices (GMP) related to microbial contamination control.
4. Provide understanding in microbial evaluation techniques such as sterility testing, microbial limit tests, and microbial assay.
5. Familiarize students with sterilization technologies, microbial spoilage control, and in vitro cell culture techniques for pharmaceutical research and quality assurance.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the basic concepts of microbiology and the role of microorganisms in pharmaceuticals.
2	Identify and differentiate microorganisms using staining and biochemical techniques.
3	Evaluate microbial contamination sources and apply GMP-based strategies for contamination control.
4	Describe microbial spoilage mechanisms and select appropriate disinfectants, antiseptics, or preservatives.
5	Compare various sterilization methods and assess their effectiveness and validation parameters and perform microbial limit and sterility tests in compliance with pharmacopeial guidelines.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Introduction and role of microorganisms in pharmaceutical industry** • Fundamentals of microbiology: Microorganisms and medicines, Introduction to various microorganisms, Microbial cultivation, isolation and enumeration. Pharmaceutical importance of microorganisms. • Introduction to Microscope (Compound and Electron Microscope) • Identification of bacteria using staining techniques (simple, Gram's &Acid-fast staining) and biochemical tests (IMViC). • Antibiotics produced by microbiology (Production and uses streptomycin, cephalosporin)	09 Hours
II	**Evaluation of microbiological contamination** • Sources and types of microbial contaminant • Control of microbial contamination during manufacture of Nonsterile dosage forms and sterile dosage forms (including Aseptic area), control of Atmosphere, Water, Raw material, Facility, Packaging, Equipment • Microbiological spoilage of pharmaceuticals, Factors affecting microbial spoilage of pharmaceuticals. • Introduction to Fermentation, types and fermenters.	09 Hours
III	**Microbial control and evaluation** Designing of aseptic area. Laminar flow equipment's, clean area classification, Biological Safety Level categories. Methods of prevention. Disinfectants, antiseptics, and preservatives, and their evaluation, Factors affecting the antimicrobial activity of disinfectants	09 Hours
IV	**Sterilization procedures, assurance and evaluation** • Physical, chemical, gaseous, radiation and mechanical methods of sterilization, Advances sterilization technologies, Evaluation of efficiency of sterilization; Validation of sterilization procedures and Sterility indicators. • Sterility assurance, Bioburden determination, Modelling in predicting microbial growth and death, Test for bacteriostatic, bactericidal activity	09 Hours
V	**Microbiological quality control** • Microbial limit tests and Microbial assay (antibiotics, vitamins and amino acids) • Sterility testing of products according to IP, BP and USP • Methods for monitoring Water and Air Quality In vitro cell cultures, general procedure for cell culture, Application of cell cultures in pharmaceutical industry and research	09 Hours

Recommended References *(Preferably latest editions):*

1. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. *Microbiology: Concepts and Applications.* McGraw-Hill.
2. Prescott, L. M., Harley, J. P. and Klein, D. A. *Microbiology.* McGraw-Hill.
3. Hugo, W. B. and Russell, A. D. *Pharmaceutical Microbiology.* Blackwell Science.
4. Waites, M. J., Morgan, N. L., Rockey, J. S. and Higton, G. *Industrial Microbiology: An Introduction.* Blackwell Science.
5. Denyer, S. P., Hodges, N. A. and Gorman, S. P. *Hugo and Russell's Pharmaceutical Microbiology.* Wiley-Blackwell.
6. Atlas, R. M. *Handbook of Microbiological Media.* CRC Press.
7. Sandle, T. *Pharmaceutical Microbiology: Essentials for Quality Assurance and Quality Control.* Elsevier.
8. Sutton, S. V. W. *Microbiology in Pharmaceutical Manufacturing.* PDA/DHI Publishing.

Course Code	Course Title			Course Type
BP309P	**General Pharmacology (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
2	--	--	4	60
Maximum Marks	SE		ESE	
50	20		30	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the historical and foundational aspects of experimental pharmacology
2. Develop knowledge and practical awareness of ethical and regulatory standards in laboratory animal care and use, as outlined in CCSEA guidelines
3. Acquire skills in pharmacological data acquisition and analysis
4. Interpret and construct dose-response curves (DRCs) and calculate and interpret pharmacological indices such as LD50, threshold and ceiling dose, slope of DRC, and PD_2,
5. Calculate the pharmacokinetic parameters and analyse the roles of pharmacokinetic parameters in the drug effects, and dosing schedule.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Identify and describe the pharmacological actions of drugs on different physiological systems and understand their therapeutic relevance.
2	Design basic pharmacological experiments and analyse the results to determine drug efficacy and safety.
3	Apply the knowledge of drug mechanisms and interactions to predict clinical outcomes.
4	Develop skills for documentation, data collection, and report preparation of experimental pharmacological investigations.
5	Understand the importance of pharmacology in drug development, clinical research, and its application in medical practice

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. To describe the contributions of renowned pharmacologists and their discoveries based on pharmacological experiments (Any 5 Noble Laureates whose research contributed to the development of Pharmacology). 2. To study various laboratory safety precautions, hazards, personal hygiene, commonly used tools, devices and instruments in experimental pharmacology. 3. To study common experimental animals including transgenic animals along with their applications in the pharmacological experiments in current drug discovery paradigm. 4. To study concept of 6Rs along with the maintenance and experimentation on laboratory animals as per the CCSEA guidelines. 5. To demonstrate collection/isolation of DNA and RNA using computer simulations and audiovisual aids. 6. To study important anaesthetics and euthanasia procedures for experimental animals. 7. To demonstrate different routes drug administration using computer simulation and understand the significance of each route along with the maximum administrable dose. 8. To study preparation of different types of physiological salt solutions (PSS), cell culture media and to understand the role of each ingredient used in PSS preparation. 9. To study the instrumentation used for isolated tissue experiments (students organ bath assembly) and recent development in recording of the responses of isolated tissues. 10. To record the dose response curve of any two agonists on suitable isolated tissue preparation using computer simulation experiment. 11. To study the potentiating effect of physostigmine on DRC of acetyl choline through interactive computer simulation. 12. To study antagonizing effect of d-tubocurarine on the DRCs of acetylcholine through interactive computer simulation. 13. To determine of PD2 of given agonists using isolated tissue preparation using computer simulation experiment. 14. To study and determine various pharmacokinetic parameters (Cmax, Tmax, Ke, t½, Vd, Clt, AUC, AUMC) from given hypothetical data. 15. To estimate LD_{50} using hypothetical data through computer-simulated experimentation (as per OECD 425 guideline) using software. 16. Software based quantification of micronucleus test and chromosomal aberration test 17. Software based prediction of teratogenicity. 18. Use of UV-Spectrophotometer for studying drug-protein interactions. **PCI recommended software's shall be used for performing experiments.*
Recommended References *(Preferably latest editions)*: 1. Ghosh, M. N. *Fundamentals of Experimental Pharmacology.* Hilton & Company, Kolkata.

2. Vogel, H. G. Drug Discovery and Evaluation: Pharmacological Assays. Springer.
3. Hofmann, F. B. Handbook of Experimental Pharmacology (HEP Series). Springer Nature.
4. Organisation for Economic Co-operation and Development. *OECD Guidelines for the Testing of Chemicals.*
5. International Council for Harmonisation. *ICH Guideline S7A: Safety Pharmacology Studies for Human Pharmaceuticals.*
6. International Council for Harmonisation. *ICH Guideline S7B: Nonclinical Evaluation of the Potential for Delayed Ventricular Repolarization.*

Course Code	Course Title		Course Type	
BP310P	**Heterocyclic Compounds and Stereo Chemistry (Practical)**		Core	
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
2	--	--	4	60
Maximum Marks	SE		ESE	
50	20		30	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand basic laboratory safety rules and learn how to handle chemicals and glassware properly.
2. Gain hands-on experience in preparing, purifying, and identifying organic compounds.
3. Learn practical techniques to separate components of binary organic mixtures.
4. Learn digital tools for drawing chemical structures and Chemical Reactions.
5. Determine molecular properties of aromatic organic and heterocyclic compounds

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Draw organic compound structures using chemical drawing tools.
2	Explain and apply techniques for purification and characterization of organic compounds.
3	Synthesize organic compounds through practical laboratory methods.
4	Analyze and separate binary organic mixtures using suitable experimental techniques.
5	Determine molecular properties of aromatic organic and heterocyclic compounds.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. Prepare, purify and characterize melting point, recrystallization following organic compounds (Minimum of 04 aromatic and any two heterocyclic compounds with different chemical reactions) a. Benzanilide/phenyl benzoate/acetanilide from aniline/ phenol by acetylation/acylation reaction. b. 2,4,6-Tribromo aniline from aniline/*para* bromo acetanilide from Acetanilide by halogenation (Bromination) reaction. c. 5-Nitro salicylic acid from salicylic acid / *meta* di-nitro benzene from nitro benzene by nitration reaction. d. Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis

reaction.

e. 1-Phenyl-azo-2-napthol from aniline by diazotization and coupling reactions.
f. Synthesis of 2,4,6- trinitrophenol by nitration reaction
g. Synthesis of 3,5-dimethyl pyrazole from acetylacetone.
h. Synthesis of benzimidazole from ortho phenylene diamine
i. Preparation of benzophenone oxime.

2. Qualitative analysis of binary mixture of organic compounds (any two) (Acid + Neutral and Base + Neutral).
3. To draw and visualize 3D structures, calculate molecular properties and to draw Chemical reactions using software tools

Recommended References *(Preferably latest editions)*:

1. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A. R. *Vogel's Textbook of Practical Organic Chemistry.* Pearson Education.
2. Mann, F. G. and Saunders, B. C. *Practical Organic Chemistry.* Pearson Education.
3. Pavia, D. L., Lampman, G. M. and Kriz, G. S. *Introduction to Organic Laboratory Techniques: A Small Scale Approach.* Brooks/Cole.

Course Code	Course Title		Course Type	
BP311P	**Pharmaceutical Dosage Forms I (Practical)**		Core	
Credit	Hours Per Week (L-T-P)			Max. Hours.
	L	T	P	
1	--	--	3	45
Maximum Marks	SE		ESE	
50	20		30	

COURSE OBJECTIVES:

The objectives of this course are to:

1. Provide understanding on preformulation principles and evaluation of key parameters for drugs, excipients, and dosage forms.
2. Provide understanding of drug–excipient compatibility testing during formulation development.
3. Provide hands-on experience in manufacturing processes and evaluation for solid dosage forms.
4. Provide hands-on experience in manufacturing processes and evaluation for sustained/controlled-release dosage forms and microcapsules.
5. Provide fundamentals of packaging material evaluation.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Conduct preformulation studies to evaluate physicochemical properties of drugs and excipients relevant to dosage form development.
2	Assess drug–excipient compatibility using appropriate experimental techniques during formulation development.
3	Formulate and evaluate solid dosage forms, including tablets and capsules, using suitable manufacturing methods.
4	Formulate and evaluate modified-release dosage forms and microcapsules using appropriate formulation and coating techniques.
5	Evaluate pharmaceutical packaging materials and understand their role in ensuring product stability and quality.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. Preformulation study of any drug/excipient as per pharmacopoeia. 2. Evaluation of powder flow properties for tablet blends. 3. Evaluation of effect of lubricating agents on powder flow properties. 4. Preparation and evaluation of tablets by direct compression.

5. Preparation and evaluation of tablets by dry granulation.
6. Preparation and evaluation of tablets by wet granulation.
7. Quality control of marketed tablets (IR, coated, enteric-coated).
8. Preparation and evaluation of coated tablets.
9. Comparison of dissolution profiles of marketed preparations.
10. Preparation and evaluation of hard-/non-gelatin capsules (fill weight, disintegration).
11. Virtual demonstration: hard-gelatin shell and soft-gel manufacturing (with overview of aseptic line/isolator).
12. Evaluation of packaging materials: primary and secondary/tertiary.
13. Preparation and evaluation of sustained-release tablets.
14. Preparation and evaluation of enteric-coated tablets.

Recommended References (Preferably latest editions):

1. Aulton, M. E. *Aulton's Pharmaceutics: The Science of Dosage Form Design.* Elsevier.
2. Lachman, L., Lieberman, H. A. and Kanig, J. L. *The Theory and Practice of Industrial Pharmacy.* CBS Publishers & Distributors.
3. Troy, D. B. and Beringer, P. *Remington: The Science and Practice of Pharmacy.* Pharmaceutical Press.
4. Gibson, M. *Pharmaceutical Preformulation and Formulation.* CRC Press.
5. Robinson, J. R. and Lee, V. H. L. *Controlled Drug Delivery: Fundamentals and Applications.* CRC Press.
6. *Indian Pharmacopoeia.* Indian Pharmacopoeia Commission.

Course Code*	Course Title*		Course Type
BP312P AEC1	Nutraceuticals and Functional Foods		Elective
BP312P AEC2	Food Analysis		
BP312P AEC3	Yoga and Life Sciences		
Credit	Hours Per Week (L-T-P)		
	L	T	P
1	--	--	1
Maximum Marks	SE		ESE
50	20		30

* Only 1 elective course shall be selected
The syllabi for elective subjects are given in the *appendix*

Semester IV

Course Code	Name of the course	No. of hours per week (L/P)	Credit points
BP401T	Herbal Drug Technology (Theory)	3	3
BP402T	Medicinal Chemistry (Theory)	3	3
BP403T	Pharmaceutical Biotechnology (Theory)	3	3
BP404T	Social Pharmacy and Public Health (Theory)	2	2
BP405T	Systemic Pharmacology I (Theory)	3	3
BP406P	Herbal Drug Technology (Practical)	3	1
BP407P	Medicinal Chemistry (Practical)	3	1
BP408P	Pharmaceutical Biotechnology (Practical)	3	1
BP409P	Social Pharmacy and Public Health (Practical)	2	1
BP410P	Systemic Pharmacology I (Practical)	3	1
BP411I	Internship (Mandatory)	8	4
Total		**28**	**23**

Course Code	Course Title			Course Type
BP401T	**Herbal Drug Technology (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand and apply plant tissue culture techniques and related approaches for biomass and secondary metabolite production.
2. Introduce biomanufacturing concepts in herbal drug technology, including plant-based production systems and edible vaccines.
3. Develop skills in the preparation and optimization of standardized herbal extracts using metabolite analysis and TLC fingerprinting.
4. Study the formulation of herbal products using standardized extracts in conventional and novel dosage forms.
5. Understand quality control, standardization, regulatory guidelines, and interaction studies for safe herbal drug development.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Demonstrate tissue culture applications for herbal drug production and edible vaccines.
2	Summarize the concept of standardized extracts and incorporate them in herbal formulations and cosmetics.
3	Apply analytical methods for quality control of herbal preparations.
4	Analyze herb–drug/food interactions and their clinical significance.
5	Interpret national regulatory provisions and global standards related to herbal drug development.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Plant Tissue Culture and Standardized Extracts:** **Plant tissue culture as an alternative source of medicine:** • Historical development • Types of cultures • Nutritional requirements • Growth and maintenance of callus and suspension culture • Role of elicitation, genetic transformation, biotransformation, precursor feeding, and somaclonal variation in biomass and secondary metabolite production **Introduction to biomanufacturing:** • Medicinal plant–based biomanufacturing • Utilising plant factories in obtaining valuable ingredients for food, pharmaceutical, and cosmetic industries • Examples: **Shikonin and Paclitaxel** • Oral vaccines in healthcare **Optimization and production of standardized extracts of medicinal plants:** Strategies for preparation of desired quality extracts by optimizing and adjusting bioactives ensuring quality using analysis of metabolites and TLC fingerprints of the following: • Aqueous and hydro-alcoholic extracts of **Ashwagandha, Shatavari, Licorice, Neem, and Haritaki** • Flavonoid-rich fraction of **Sweet lime peel** • Terpenoid-rich fraction of **Bacopa** • Phenol-rich fraction of **Green Tea** • Steroid-rich fraction of **Tribulus** • Alkaloid-rich fraction of **Vasaka**	10 Hours

II	**Herbal Formulations, Excipients and Cosmetics:** **Herbal formulations:** • Conventional herbal formulations: syrups, mixtures, powders, capsules, tablets, creams, ointments • Novel dosage forms: phytosomes (phytocomplexes), liposomes, nanoformulations • Composition, preparation, and characterization using standardized extracts and bioactives **Herbal cosmetics:** • Sources and description of raw materials of herbal origin as active agents in skincare, hair care, and oral hygiene products • Applications in skincare, hair care, and oral hygiene products such as: Sunscreen-lotion/gel Hair oil, shampoo, herbal dye Herbal mouthwash, chewing gums, candies, gargles • Face serums and herbal face packs **Excipients of Natural origin** • Colorants, sweeteners, binders, diluents	10 Hours

	• Viscosity builders, disintegrants • Flavors and perfumes • Protective agents, waxes, bleaching agents and antioxidants	
III	**Quality Control and Standardisation of Herbal Medicines:** • WHO, AYUSH, and EU guidelines on quality control, stability, and shelf life studies of herbal medicines • Approaches for standardisation and quality control of botanicals and formulations • Testing methods and regulatory considerations • Role of DNA fingerprint and molecular markers such as **rbcL, matK, and SCAR** in quality control • **Forensic pharmacognosy:** Role in identification of illicit herbal drugs (e.g., **Cannabis, Opium**)	7 Hours
IV	**Herb–Drug / Food / Herb Interactions:** • General introduction to interactions and role of ADME, Cytochrome P450, and P-gp • **Herb–drug interactions:** St. John's Wort with warfarin Ginkgo biloba with aspirin • **Herb–food interactions:** Licorice with salty foods Turmeric with fats Green tea with iron-rich foods • **Herb–herb interactions:** Ephedra with Ginseng Chamomile with Valerian • Adverse reactions related to plants and foods such as allergy, intolerance, and toxicity	10 Hours
V	**Regulatory Requirements of Herbal Drugs and Botanicals:** **Regulatory framework in India for Herbal and ASU medicines:** a) Role of regulatory bodies b) ASU DTAB (Ayurveda, Siddha, and Unani Drugs Technical Advisory Board) c) ASU DCC (Drugs Consultative Committee for ASU drugs) d) Schedule T – GMP requirements for ASU drugs e) Schedule E1 – Poisonous drugs listed under AYUSH f) Drugs and Cosmetics Act – Regulatory provisions relevant to herbal/ASU medicines, procedures for registration, trade, and export g) Concept of **Phytopharmaceuticals** and **Ayush Aahara** in bridging Indian traditional knowledge with modern science.	8 Hours

Recommended References (Preferably latest editions):

1. Waldesch, F. G. *Herbal Medicinal Products.* CRC Press.
2. *Indian Herbal Pharmacopoeia.* Indian Drug Manufacturers' Association.
3. World Health Organization. *Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants.*
4. *Drugs and Cosmetics Act and Rules (India).* Government of India.

Course Code	Course Title			Course Type
BP402T	**Medicinal Chemistry (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are to:

1. Develop a comprehensive understanding of the fundamental principles of medicinal chemistry, including physicochemical properties, drug metabolism, and prodrug concepts.
2. Classify and describe the chemical structures, therapeutic uses, and structure–activity relationships of drugs acting on the autonomic and cardiovascular systems.
3. Apply the principles of structure–activity relationships (SAR) to explain and predict the pharmacological activity.
4. Understand the synthetic pathways of drugs, emphasizing important reaction steps and chemical transformations.
5. Analyze the relationship between drug structure and pharmacological activity in relation to therapeutic efficacy and safety.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Relate the physicochemical properties of drug molecules to their biological activity and pharmacokinetic behavior.
2	Categorize drugs affecting the autonomic nervous system and predict their therapeutic outcomes.
3	Analyze and interpret the structure-activity relationships of selected drug classes (e.g., beta-blockers, local anesthetics, thiazide diuretics, NSAIDs) to optimize drug design.
4	Outline the synthetic routes of selected drugs, identifying key intermediates and reactions involved in their preparation.
5	Correlate the chemical structure of drugs with their therapeutic uses and potential adverse effects. Apply the knowledge of medicinal chemistry principles to understand and potentially contribute to the drug discovery and development process.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
	Study of the development of the following classes of drugs, Chemical Classification, Structure, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and Synthesis of selected drugs as superscripted (*)	
I	**Fundamentals of Medicinal Chemistry** • **Introduction:** History and scope of medicinal chemistry • **Physicochemical properties in relation to biological action:** Ionization, solubility, partition coefficient, hydrogen bonding, Chelation, Bioisosterism and protein binding • **Drug metabolism:** Phase I & II reactions	7 hours
II	**Drugs Acting on the Autonomic Nervous System** 1. **Adrenergic or Sympathomimetic agents:** Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline, Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine, Metaraminol. 2. **Anti-adrenergic or Sympatholytic agents:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetalol, Carvedilol. SAR of beta adrenergic blockers. 3. **Cholinergic or Parasympathomimetic agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine, Physostigmine, Neostigmine, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion. Pralidoxime chloride. **4. Anti-Cholinergic or Parasympatholytic agents:** Atropine, Hyoscyamine, Scopolamine, Homatropine, Ipratropium*, Tropicamide, Cyclopentolate, Clidinium Glycopyrrolate, Dicyclomine*, Methantheline, Propantheline, Benztropine mesylate, Orphenadrine, Biperidine, Procyclidine, Tridihexethyl, Isopropamide, Ethopropazine, SAR of cholinergic blockers. 5. **Local anesthetic agents:** Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. Benzocaine, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate, Lignocaine, Mepivacaine, Prilocaine, Etidocaine, Phenacaine, Diperodon, Dibucaine.* SAR of Local anesthetics.	15 hours
III	**Drugs Acting on the Cardiovascular System** 1. **Anti-anginals:** Amyl nitrite, Nitroglycerin, Pentaerythritol, Isosorbide dinitrite*, Dipyridamole, Verapamil, Bepridil hydrochloride, Diltiazem, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.	09 hours

	2. Anti-hypertensives: Timolol, Captopril, Lisinopril, Enalapril, Benazepril, Quinapril, Methyldopate,* Clonidine, Guanethidine, Guanabenz, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine. **3. Drugs to treat Congestive Heart Failure (CHF):** Digoxin, Digitoxin, Nesiritide, Bosentan,Tezosentan. **4. Anti-arrhythmics (Class I–IV):** Quinidine sulphate, Procainamide, Disopyramide*, Phenytoin, Lidocaine, Tocainide, Mexiletine, Lorcainide, Amiodarone, Sotalol.	
IV	**Drugs acting on blood and Renal System** **1. Antihyperlipidemic Agents:** Fenofibrate*, Lovastatin, Cholesteramine and Cholestipol **2. Coagulants and Anti-Coagulants:** Menadione, Acetomenadione, Warfarin, Anisindione, clopidogrel. 3. **Diuretics:** Acetazolamide*, Methazolamide, Dichlorphenamide, Chlorthiazide, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Furosemide*, Bumetanide, Ethacrynic acid, Spironolactone, Triamterene, Amiloride. Mannitol. SAR of Thiazides.	06 hours
V	**Autacoids and related drugs** **1. Antihistamines** **a. H1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines, Clemastine, Diphenylphyraline, Tripelenamine, Chlorcyclizine, Meclizine, Buclizine, Chlorpheniramine, Triprolidine, Phenindamine, Promethazine*, Trimeprazine, Cyproheptadine, Azatidine, Astemizole, Loratadine, Cetirizine, Levocetrizine Cromolyn. **b. H2-antagonists:** Cimetidine*, Famotidine, Ranitidine. **2. Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole **Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), Antipyretics:** Sodium salicylate, Aspirin, Diflunisal, Mefenamic acid*, Niflumic acid, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone, Celecoxib, Etoricoxib, SAR of representative agents by class.	08 hours

Recommended References (Preferably latest editions):

1. Lemke, T. L., Williams, D. A. and Roche, V. F. *Foye's Principles of Medicinal Chemistry.* Lippincott Williams & Wilkins.
2. Beale, J. M., Thomas, J. T. and Duckett, M. H. *Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry.* Lippincott Williams & Wilkins.
3. Abraham, D. J. and Griffin, J. L. *Burger's Medicinal Chemistry and Drug Discovery.* Wiley.
4. Patrick, G. L. *An Introduction to Medicinal Chemistry.* Oxford University Press.
5. Lednicer, D. *The Organic Chemistry of Drug Synthesis.* Wiley.
6. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A. R. *Vogel's Textbook of Practical Organic Chemistry.* Pearson Education.
7. Brunton, L., Hilal-Dandan, R. and Knollmann, B. *Goodman and Gilman's The Pharmacological Basis of Therapeutics.* McGraw-Hill Education.
8. Williams, D. A. Foye's Principles of Medicinal Chemistry. Lippincott Williams & Wilkins.

Course Code	Course Title			Course Type
BP403T	**Pharmaceutical Biotechnology (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand and apply plant tissue culture techniques and related approaches for biomass and secondary metabolite production.
2. Introduce biomanufacturing concepts in herbal drug technology, including plant-based production systems and edible vaccines.
3. Develop skills in the preparation and optimization of standardized herbal extracts using metabolite analysis and TLC fingerprinting.
4. Study the formulation of herbal products using standardized extracts in conventional and novel dosage forms.
5. Understand quality control, standardization, regulatory guidelines, and interaction studies for safe herbal drug development.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the role of biotechnology in pharmaceutical sciences, including monoclonal antibodies and enzyme immobilization.
2	Apply genetic engineering and recombinant DNA technology for the production of biopharmaceuticals such as insulin, interferons, and vaccines.
3	Describe microbial biotransformation and analyze fermentation processes used in pharmaceutical industries.
4	Assess the role of bioinformatics and artificial intelligence in the Human Genome Project and personalized medicine.
5	Describe vaccine and sera development, including preparation, evaluation, standardization, and regulatory requirements, and critically evaluate challenges and emerging approaches in vaccine and sera development and commercialization

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Introduction to Pharmaceutical Biotechnology** Introduction to biotechnology in pharmaceutical sciences; protein	9 Hours

	therapeutics; analytical characterization of proteins; monoclonal antibodies; antigens; enzyme immobilization; cell culture and immobilization techniques; pharmaceutical applications.	
II	**Genetic Engineering and Recombinant DNA Technology** Principles of genetic engineering; recombinant DNA technology; production of interferons, hepatitis-B vaccine, and insulin; polymerase chain reaction (PCR) and its applications; mutations and types of mutants.	9 Hours
III	**Microbial Biotransformation and Fermentation Technology** Microbial biotransformation; fermentation principles and process control; industrial production of alcohol, penicillins, citric acid, and vitamin B_{12}; blood products—collection, processing, and storage.	9 Hours
IV	**Gene Therapy, Genomics and Personalized Medicine** Gene therapy—types and methodologies; delivery systems; ethical concerns and challenges; Human Genome Project; role of bioinformatics and artificial intelligence in personalized medicine.	9 Hours
V	**Immunology, Vaccines and Sera** Basics of immunology; types and generations of vaccines; immunization strategies; vaccine preparation, evaluation, and standardization; regulatory aspects; sera therapy; marketed products; challenges and newer approaches.	9 Hours

Recommended References (Preferably latest editions):

1. Crommelin, D. J. A., Sindelar, R. D. and Meibohm, B. *Pharmaceutical Biotechnology: Fundamentals and Applications.* Springer.
2. Walsh, G. *Biopharmaceuticals: Biochemistry and Biotechnology.* Wiley-Blackwell.
3. Brown, T. A. *Gene Cloning and DNA Analysis: An Introduction.* Wiley-Blackwell.
4. Glick, B. R., Pasternak, J. J. and Patten, C. L. *Molecular Biotechnology: Principles and Applications of Recombinant DNA.* ASM Press.
5. Doran, P. M. *Bioprocess Engineering Principles.* Academic Press.
6. Vogel, H. C. and Todaro, C. L. *Fermentation and Biochemical Engineering Handbook.* William Andrew.
7. Primrose, S. B., Twyman, R. M. and Old, R. W. *Principles of Gene Manipulation and Genomics.* Wiley-Blackwell.
8. Strachan, T. and Read, A. *Human Molecular Genetics.* Garland Science.
9. Plotkin, S. A., Orenstein, W. A., Offit, P. A. and Edwards, K. M. *Plotkin's Vaccines.* Elsevier.
10. Kindt, T. J., Goldsby, R. A., Osborne, B. A. and Kuby, J. *Kuby Immunology.* W. H. Freeman.
11. Janeway, C. A., Travers, P., Walport, M. and Shlomchik, M. *Janeway's Immunobiology.* Garland Science.

Semester-IV

Course Code	Course Title			Course Type
BP404T	**Social Pharmacy and Public Health (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
2	2	--	--	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand the concepts of social pharmacy, public health, and their interrelation.
2. Identify the social determinants of health and their impact on health outcomes and medication use.
3. Recognize the role of pharmacists in public health initiatives, health promotion, and disease prevention.
4. To gain knowledge about the Indian healthcare system, national health policies, and important health programs.
5. To understand basic epidemiological principles and their application in public health.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Describe the scope of social pharmacy and the pharmacist's role in the public health system.
2	Explain the influence of socio-cultural and behavioral factors on health, illness, and medication adherence.
3	Discuss various national health programs and the pharmacist's contribution to their success.
4	Apply basic principles of epidemiology to understand disease distribution and control.
5	Develop health education materials and counsel patients on preventive healthcare measures and rational drug use.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Introduction to Social Pharmacy and Public Health** a) Social Pharmacy: Definition, scope, historical development, and importance. Social pharmacy as a multidisciplinary field.	6 Hours

	b) Public Health: Definition, concepts, history, core functions, and ethical considerations. c) Interplay between Social Pharmacy and Public Health: The evolving role of the pharmacist in the public health arena. d) Concept of Health and Disease: WHO definition of health; dimensions of health – physical, mental, social, spiritual, and environmental. e) Determinants of Health: Social, economic, environmental, lifestyle, and healthcare service determinants and their impact on population health. f) Health Indicators: Indicators used to measure health status and health outcomes in a population.	
II	**Health Systems, Policy, and Pharmacoepidemiology** a) Healthcare Delivery Systems: Overview of global healthcare systems. b) Indian Healthcare System: Structure, public and private sectors, primary, secondary, and tertiary levels of care. c) Health Policy: Introduction to health policy formulation and analysis; objectives of India's National Health Policy. d) National Health Mission (NHM): NRHM and NUHM – goals, strategies, and impact on public health indicators. e) Pharmacoepidemiology: Definition, aims, scope, and applications. f) Measures of Disease Frequency and Distribution: Incidence, prevalence, endemic, epidemic, pandemic; morbidity and mortality rates, Odds ratio and relative risk. g) Introduction to Biostatistics: Role in public health; types of data; basic data presentation methods.	6 Hours
III	**Preventive Healthcare, Health Promotion, and Communicable Diseases** a) Levels of Prevention: Primordial, primary, secondary, and tertiary prevention with examples. b) Role of Pharmacists in Disease Prevention and Health Promotion: Immunization services, screening programs, lifestyle counselling. c) Health Education: Definition, principles, methods, and importance; development of effective health education materials. d) Mother and Child Health (MCH): Antenatal care, postnatal care, breastfeeding, immunization schedules. e) Communicable Diseases: Modes of transmission, prevention, and control of tuberculosis, HIV/AIDS, malaria, dengue, typhoid, influenza; pharmacist's role.	6 Hours
IV	**Non-Communicable Diseases, Nutrition, Mental Health, and National Programs** a) Non-Communicable Diseases (NCDs): Diabetes, hypertension, cardiovascular diseases, chronic respiratory diseases, cancer; prevention and management. b) Nutrition and Health: Balanced diet, macro- and micronutrients, malnutrition, nutritional deficiency disorders, food safety, and adulteration. c) Mental Health: Common mental disorders, stigma, promotion of mental well-being; pharmacist's role. d) National Health Programs in India: Programs related to MCH, NCDs, communicable diseases, tobacco control, and deafness prevention.	6 Hours

V	**Pharmacoeconomics, Rational Use of Medicines, Professional Roles, and Future Trends** a) Pharmacoeconomics: Introduction, significance; Cost-Benefit Analysis (CBA), Cost-Effectiveness Analysis (CEA), Cost-Utility Analysis (CUA). b) Rational Use of Medicines (RUM): Definition, importance, problems of irrational drug use; pharmacist's role. c) Medication Adherence: Factors affecting adherence, consequences of non-adherence, improvement strategies. d) Drug Misuse and Abuse: Alcohol, tobacco, opioids, prescription drug abuse; pharmacist's role. e) Professionalism and Ethics in Social Pharmacy: Ethical dilemmas in public health pharmacy. f) Disaster Management: Role of pharmacists. g) Emerging Trends: Telepharmacy, digital health, personalized medicine, expanding public health responsibilities of pharmacists.	6 Hours

Recommended References (Preferably latest editions)

1. Anderson, S., Dedrick, R. and Tiffany, B. *Community Pharmacy Practice for Public Health.* McGraw-Hill Education.
2. Desselle, S. *Public Health and Pharmacy Practice.* McGraw-Hill Education.
3. Donyai, P. *Social and Cognitive Pharmacy: Theory and Case Studies.* Pharmaceutical Press.
4. Gillam, S., Yates, J. and Badrinath, P. *Essential Public Health: Theory and Practice.* Cambridge University Press.
5. Levin, B. L. and Hanson, A. *Essentials of Public Health Pharmacy.* Jones & Bartlett Learning.
6. Park, K. *Park's Textbook of Preventive and Social Medicine.* Banarsidas Bhanot Publishers.
7. Schneider, M. J. *Introduction to Public Health.* Jones & Bartlett Learning.
8. Taylor, K. and Harding, G. *Pharmacy Practice.* CRC Press.
9. Wertheimer, A., Ibrahim, M. I. M. and Babar, Z. U. D. *Social and Administrative Aspects of Pharmacy in Low- and Middle-Income Countries.* Elsevier.

Course Code	Course Title			Course Type
BP405T	**Systemic Pharmacology I (Theory)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
3	3	--	--	45
Maximum Marks	SE			ESE
75	30			45

COURSE OBJECTIVES:

The objectives of this course are to:

1. Develop a comprehensive understanding of neurohumoral transmission, neurotransmitters, and the organization and function of the autonomic nervous system.
2. Provide knowledge of the classification, mechanisms of action, and pharmacological effects of various classes of drugs.
3. Explain the pharmacology of drugs acting on the peripheral nervous system, cardiovascular system, and urinary system.
4. Describe the physiological roles of autacoids and the pharmacology of drugs used in the management of pulmonary diseases and related disorders.
5. Familiarize students with the pharmacology of drugs acting on the immune system, hematopoietic system, and blood, and relate pharmacological principles to clinical conditions through case-based learning.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Explain the classification of neurotransmitters and describe neurohumoral transmission, including the organization, function, and pharmacological modulation of the autonomic nervous system.
2	Classify and explain the mechanisms of action, pharmacological effects, and therapeutic uses of drugs used in cardiovascular disorders such as heart failure, arrhythmias, hypertension, angina, and lipid disorders.
3	Describe the pharmacology and therapeutic uses of drugs acting on blood and kidney, including anticoagulants, antiplatelet agents, hematinics, and diuretics.
4	Explain the physiological roles of autacoids and analyze the pharmacology of drugs that modulate autacoid pathways, including antihistamines, antimigraine agents, NSAIDs, and antirheumatic drugs.
5	Evaluate the mechanisms of action, therapeutic uses, and adverse effects of drugs acting on the respiratory and immune systems.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures
I	**Pharmacology of drugs acting on the peripheral nervous system** a) Organization and functions of PNS. b) Neurohumoral transmission, co-transmission. Neurotransmitters and their receptors, including non-adrenergic and non-cholinergic (NANC) neurotransmitters. c) Parasympathomimetic and Parasympatholytic drugs. d) Sympathomimetic and sympatholytic drugs. e) Skeletal muscle relaxants (peripheral and central). f) Drugs used in the treatment of myasthenia gravis and glaucoma	10 Hours
II	**Pharmacology of drugs acting on the cardiovascular system** a) Introduction to cardiovascular hemodynamic and cardiac electrophysiology. b) Drugs used in congestive cardiac failure. c) Anti-arrhythmic drugs. d) Anti-anginal and newer anti-ischemic drugs. e) Anti-hypertensive drugs. f) Shock, types of shocks and drugs used in their management. g) Stroke, types of strokes and drugs used in their management	10 Hours
III	**Pharmacology of drugs acting on blood and kidney** 1. Pharmacology of drugs acting on blood a) Anti-platelet agents b) Coagulants and anticoagulants. c) Fibrinolytics and Plasma expanders. d) Haematinics. e) Anti-hyperlipidaemic drugs. 2. Pharmacology of drugs acting on kidney a) Diuretics. b) Anti-diuretics.	10 Hours
IV	**Pharmacology of autacoids and related drugs** a) Introduction to autacoids and their classification. Therapeutic significance of important agonists and antagonists of prostaglandins, thromboxane, leukotrienes, angiotensin, bradykinin and substance P. b) Histamine and antihistamines. c) 5-HT, its agonists and antagonists, drugs used in migraine. d) Non-steroidal anti-inflammatory drugs, antipyretics and analgesics. e) Anti-gout and Antirheumatic drugs including Disease Modifying Antirheumatic Drugs (DMARDs).	9 Hours
V	**i) Pharmacology of Drugs acting on respiratory system** a) Drugs used in the treatment of bronchial asthma and COPD. b) Definitions, classification and therapeutic uses of nasal decongestants, mucolytics, expectorants and antitussives. c) Respiratory stimulants.	6 Hours

	ii) Pharmacology of Drugs acting on immune system Mechanism of action, adverse effects and therapeutic uses of important classes of immune stimulants and immunosuppressants.	

Recommended References (Preferably latest editions):

1. Brunton, L., Hilal-Dandan, R. and Knollmann, B. *Goodman and Gilman's The Pharmacological Basis of Therapeutics.* McGraw-Hill Education.
2. Craig, C. R. and Stitzel, R. E. *Modern Pharmacology with Clinical Applications.* Lippincott Williams & Wilkins.
3. DiPiro, J. T., Talbert, R. L., Yee, G. C. and Matzke, G. R. *Pharmacotherapy: A Pathophysiologic Approach.* McGraw-Hill Education.
4. Katzung, B. G. and Trevor, A. J. *Basic and Clinical Pharmacology.* McGraw-Hill Education.
5. Rang, H. P., Dale, M. M., Ritter, J. M., Flower, R. J. and Henderson, G. *Rang and Dale's Pharmacology.* Elsevier.
6. Tripathi, K. D. *Essentials of Medical Pharmacology.* Jaypee Brothers Medical Publishers.

Course Code	Course Title			Course Type
BP406P	**Herbal Drug Technology (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are:

1. To apply seed germination and plant tissue culture techniques for medicinal plants.
2. To prepare and standardize herbal extracts and phytoconstituent-enriched fractions as per Pharmacopoeial procedures.
3. To evaluate natural excipients and standardized herbal extracts for formulation development.
4. To develop and evaluate herbal cosmetic, pharmaceutical, and novel delivery systems using standardized extracts.
5. To assess the quality of marketed herbal formulations and extracts through experiential learning and surveys.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Perform seed germination and plant tissue culture of medicinal plants.
2	Prepare and standardize herbal extracts and enriched phytoconstituent fractions following official guidelines.
3	Evaluate excipients of natural origin and select suitable ingredients for herbal formulations.
4	Formulate and assess herbal cosmetics, dosage forms, and novel delivery systems as per Pharmacopoeial standards.
5	Analyze and compare marketed herbal medicines and cosmetics for quality, compliance, and performance

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. To establish seed germination and plant tissue culture of a medicinal plant. 2. Preparation and standardization of extracts of Phenol-rich fraction of Green Tea. 3. Preparation and standardisation of Aqueous and hydro-alcoholic extracts of Ashwagandha or Haritaki (as per IP procedure) 4. Preparation and standardization of Flavonoid-enriched fraction of Sweet lime peel

5. Preparation and standardization of Terpenoid-rich fraction of Bacopa.
6. Preparation and standardization of Steroid-rich fraction of Tribulus
7. Preparation and standardization of Alkaloid-rich fraction of Vasaka
8. Evaluation of excipients of natural origin.
9. To develop and evaluate herbal cosmetics in form of gel, cream, lotion using standardized herbal extract.
10. To develop and evaluate herbal shampoo using standardized herbal extract.
11. To develop herbal formulations in form of syrups and mixtures using standardized herbal extract and their evaluation as per Pharmacopoeial guidelines.
12. To develop herbal tablets using standardized herbal extract and their evaluation as per Pharmacopoeial guidelines.
13. Preparation of botanicals-based new herbal medicinal product delivery systems (phytosomes).
14. Experiential learning-based experiments involving collection of herbal formulations/ extracts from the market and their quality evaluation as per Pharmacopoeial guidelines.
15. Survey on different commercialized marketed herbal cosmetics.
16. Survey on different commercialized marketed herbal medicine.

Recommended References (Preferably latest editions):

1. Evans, W. C. *Trease and Evans' Pharmacognosy.* Elsevier.
2. Harborne, J. B. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.* Springer.
3. Houghton, P. J. and Raman, A. *Laboratory Handbook for the Fractionation of Natural Extracts.* Chapman & Hall.
4. Indian Pharmacopoeia Commission. *Indian Pharmacopoeia.* Indian Pharmacopoeia Commission.
5. Mukherjee, P. K. *Quality Control and Evaluation of Herbal Drugs.* Elsevier.
6. Sarker, S. D., Latif, Z. and Gray, A. I. *Natural Products Isolation.* Humana Press.
7. World Health Organization. *WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants.*
8. World Health Organization. *WHO Quality Control Methods for Herbal Materials.*

Course Code	Course Title			Course Type
BP407P	**Medicinal Chemistry (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Comprehend the fundamental principles of drug synthesis, assay, and monograph analysis.
2. Acquire practical skills in the synthesis of selected drug molecules and intermediates.
3. Develop proficiency in performing qualitative and quantitative assays of drugs.
4. Understand the requirements and procedures involved in drug monograph analysis.
5. Apply appropriate techniques and methodologies for the preparation, assay, and monograph analysis of various drugs.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Demonstrate the ability to synthesize various drug molecules and intermediates using standard laboratory procedures.
2	Perform qualitative and quantitative assays of drugs with accuracy and precision.
3	Analyze and interpret drug monographs according to pharmacopeial standards.
4	Utilize appropriate instrumentation and techniques for drug preparation, assay, and monograph analysis.
5	Document and report experimental procedures and results in a clear and concise manner.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) **1. Preparation of Drugs / Intermediates** a. Aspirin b. Benzotriazole c. Benzocaine d. Phenytoin e. Dibenzalacetone f. Paracetamol **2. Assay of Drugs *(Any 3)*** a. Aspirin b. Ibuprofen c. Furosemide d. Paracetamol **3. Monograph Analysis *(Any 3)*** a. Paracetamol b. Aspirin c. Phenobarbital d. Diclofenac e. Phenytoin
Recommended References (Preferably latest editions): 1. Abraham, D. J. and Rotella, D. P. *Burger's Medicinal Chemistry, Drug Discovery and Development.* John Wiley & Sons. 2. Beckett, A. H. and Stenlake, J. B. *Practical Pharmaceutical Chemistry.* CBS Publishers & Distributors. 3. Furniss, B. S., Hannaford, A. J., Smith, P. W. G. and Tatchell, A. R. *Vogel's Textbook of Practical Organic Chemistry.* Pearson Education. 4. Indian Pharmacopoeia Commission. *Indian Pharmacopoeia.* Indian Pharmacopoeia Commission. 5. Kar, A. *Advanced Practical Medicinal Chemistry.* New Age International Publishers. 6. Lednicer, D. *The Organic Chemistry of Drug Synthesis.* John Wiley & Sons. 7. Moffat, A. C., Osselton, M. D. and Widdop, B. *Clarke's Analysis of Drugs and Poisons.* Pharmaceutical Press. 8. United States Pharmacopeial Convention. *United States Pharmacopeia–National Formulary (USP–NF).* United States Pharmacopeial Convention. 9. Vogel, A. I. *Vogel's Textbook of Quantitative Chemical Analysis.* Longman Scientific & Technical.

Course Code	Course Title			Course Type
BP408P	**Pharmaceutical Biotechnology (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Provide fundamental knowledge of biotechnology concepts, including protein therapeutics, monoclonal antibodies, enzyme immobilization, and their pharmaceutical applications.
2. Explain the principles and applications of genetic engineering and recombinant DNA technology in pharmaceutical sciences.
3. Develop understanding of microbial biotransformation, fermentation processes, and large-scale production of pharmaceutical products such as alcohol, antibiotics, vaccines, and blood products.
4. Describe the principles, methodologies, delivery systems, and ethical considerations associated with gene therapy and modern vaccine technologies.
5. Introduce the regulatory requirements and standardization procedures for vaccines, sera, and other biopharmaceutical products.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Explain the fundamental principles of biotechnology and apply genetic engineering and recombinant DNA technology concepts in pharmaceutical sciences.
2	Describe the production and applications of biopharmaceutical products such as protein therapeutics and monoclonal antibodies.
3	Explain the principles, delivery systems, and ethical considerations associated with gene therapy.
4	Describe fermentation processes and microbial biotransformation involved in the large-scale production of pharmaceutical products such as vaccines, hormones, and blood products.
5	Explain the principles of immunization, types of vaccines and sera, and the regulatory and ethical considerations involved in the development of biopharmaceutical products.

Detailed Syllabus:

List of practical
(Minimum 12 experiments must be performed) 1. Understanding Good microbiological laboratory practices while working in Microbiology laboratory aseptic handling in microbiology lab: growth and isolation of microbes using streaking, spreading and subculturing techniques: microbial staining, study of various equipments such as loop, straight wire, spreader, forceps, pipette, test tube, petridish, burner etc and apparatus used in microbiology lab- BOD incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer and microscopes. 2. Handling of biological spill, decontamination procedures and hygiene while handling microorganisms and disposal 3. Sterilization and evaluation of glassware and apparatus using hot air oven 4. Preparation and sterilization of solid and liquid culture medium using different techniques 5. Determination of microbiological efficacy of disinfectant/ preservative efficacy test 6. Tests for sterility of ophthalmic or parenteral marketed formulation according to IP. 7. Analysis of Biotechnological product (Protein, nucleic acid materials) by UV Vis and FTIR spectrophotometer 8. Production of alcohol using Fermentation process 9. Practice Whole cell immobilization technique (any one) 10. Practice Enzyme immobilization technique and its kinetics 11. Isolation and estimation of DNA and RNA 12. Isolation of plasmids and expression of protein 13. Agarose gel electrophoresis of DNA/ RNA 14. SDS – polyacrylamide gel electrophoresis for proteins. 15. Microbiological assay of antibiotics.
Recommended References (Preferably latest editions): 1. Baltz, R. H., Davies, J. E. and Demain, A. L. *Manual of Industrial Microbiology and Biotechnology.* ASM Press. 2. Carter, S. J. *Cooper and Gunn's Tutorial Pharmacy.* CBS Publishers & Distributors. 3. Chou, S. L. M. *Practical Biotechnology: A Guide to Biochemical Engineering.* Springer. 4. Denyer, S. P., Hodges, N. A. and Gorman, S. P. *Hugo and Russell's Pharmaceutical Microbiology.* Wiley-Blackwell. 5. Glick, B. R., Pasternak, J. J. and Patten, C. L. *Molecular Biotechnology: Principles and Applications of Recombinant DNA.* ASM Press. 6. Lachman, L., Lieberman, H. A., Kanig, J. L. and Khar, R. K. *The Theory and Practice of Industrial Pharmacy.* CBS Publishers & Distributors. 7. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. *Microbiology.* McGraw-Hill.

Course Code	Course Title			Course Type
BP409P	**Social Pharmacy and Public Health (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	2	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Understand and apply basic health assessment techniques (blood pressure, BMI, and blood glucose levels), and perform essential first aid skills.
2. Gain skills in the development of health education tools and communication strategies to promote prevention and control of communicable diseases and encourage healthy lifestyle modifications.
3. Familiarize with mental health assessment tools and improve clinical communication skills through simulated role-play exercises focused on patient screening.
4. Acquire practical knowledge of immunization practices and demonstrate correct vaccine administration techniques using simulation models.
5. Understand the principles of epidemiology and designing preventive strategies for common communicable diseases. Develop foundational knowledge of Pharmacoeconomics and its applications. Evaluate health interventions, while identifying irrational drug use practices.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Perform basic health screening and first aid procedures using appropriate techniques.
2	Develop and disseminate health promotion and disease prevention materials
3	Apply mental health screening tools and demonstrate patient assessment skills using role plays and relevant psychological scales.
4	Demonstrate vaccination techniques using appropriate models and standard protocols for immunization practices.
5	Interpret epidemiological data and apply to create preventive measures Evaluate healthcare interventions using pharmacoeconomic principles and recognize irrational drug use in real-world scenarios.

Detailed Syllabus:

List of practical
(Minimum 12 Experiments must be performed; * Mandatory experiments) 1. Training on health screening services (Blood pressure, body mass index (BMI), blood glucose levels, heart rate (pulse rate), respiratory rate, body temperature, oxygen saturation (SpO_2), hemoglobin levels (basic anemia screening)). 2. Develop health promotion material for the prevention of communicable diseases. 3. Role play- usage of different mental scales in patient screening. 4. Case study on calculation of prevalence; incidence, odds ratio and relative risk. 5. Design and demonstrate preventive strategies for major communicable diseases (group activity) 6. Present a case study highlighting cost-benefit analysis in healthcare. 7. Perform cost-effectiveness analysis for selected health interventions. 8. Conduct cost-utility analysis to assess health program efficiency. 9. Perform basic first aid techniques. 10. Design informational leaflet on lifestyle modifications for disease prevention. 11. Identify and illustrate irrational drug use with a real-world example. 12. Prepare an immunization chart, interpret the vaccination schedule and perform patient counselling for vaccination*. 13. Hand wash and hand sanitizing techniques*. 14. Demonstration and practice of wound dressing in first aid and basic suturing techniques*. 15. Practical training on routes of drug administration-oral, and other non-parenteral routes*. 16. Practical training on routes of drug administration- parenteral routes*. 17. Training on basic life support (BLS)*.
Recommended References (Preferably latest editions): 1. Drummond, M. F., Sculpher, M. J., Claxton, K., Stoddart, G. L. and Torrance, G. W. *Methods for the Economic Evaluation of Health Care Programmes.* Oxford University Press. 2. Harding, G. and Taylor, K. *Social Pharmacy.* Pharmaceutical Press. 3. Park, K. *Park's Textbook of Preventive and Social Medicine.* Banarsidas Bhanot Publishers.

Course Code	Course Title			Course Type
BP410P	**Systemic Pharmacology I (Practical)**			Core
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	3	45
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Provide understanding of the theoretical and practical aspects of different pharmacological experiments using virtual simulations and video demonstrations.
2. Develop skills to assess drug effects on various systems such as cardiovascular, respiratory, skeletal muscle, and gastrointestinal tract using simulation models.
3. Familiarize the learners with experimental methodologies such as Langendorff's heart preparation, spasmogen and spasmolytic effects, and PA2 value determination using Schild plot.
4. Provide knowledge of modern techniques for drug evaluation.
5. Explore clinical pharmacology aspects through case studies on drug interactions, management of cardiovascular and respiratory diseases, and plasma volume expanders.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Describe the drug effects on blood pressure, heart rate, and understand their relevance to cardiovascular pharmacotherapy through virtual simulations.
2	Evaluate the pharmacological management of asthma, analyse drug actions on the respiratory system, and correlate them with clinical data.
3	Interpret experimental data, calculate and analyse PA2 values, plot standard curves, and estimate drug effects using hypothetical data from computer simulations.
4	Present case studies and explore drug interactions and rational drug management in cardiovascular situations and asthma, applying pharmacological knowledge to patient care.
5	Demonstrate competence in various pharmacological measurements, such as intraocular pressure estimation, nitric oxide estimation in plasma, and spirometry.

Detailed Syllabus: B.Pharm Syllabus

List of practical
(Minimum 12 Experiments must be performed)
1. To demonstrate Langendorff's heart assembly and its applications in pharmacology (only video demonstration/or charts and illustrations).
2. Recording of the effects of different electrolytes, agonists and antagonists on the isolated and perfused frog heart preparation using interactive computer simulation experiment.
3. To study the effect of various drugs on blood pressure and heart rate anaesthetized dog using interactive computer simulation experiment.
4. Demonstration of the estimation of intraocular pressure on rabbit eye and human eye by using conventional Schiotz tonometer and non-contact tonometer.
5. To evaluate the muscle relaxant activity of drugs on Rota-rod apparatus using interactive computer simulation experiment.
6. Demonstration of the effect of spasmogens and spasmolytic using rabbit jejunum using interactive computer simulation experiment.
7. Determination of PA2 value of Atropine using a suitable isolated tissue preparation by Schild plot method with the help of hypothetical data using interactive computer simulation experiment.
8. Determination of PA2 value of Prazosin using a suitable isolated tissue preparation by Schild plot method with the help of hypothetical data using interactive computer simulation experiment.
9. To study the antiallergic effects of drugs using mast cell degranulation assay using interactive computer simulated experiment.
10. Evaluation of diuretic activity of drugs in rats using metabolic cages (simulation) and estimation of electrolytes in the urine samples/serum using flame photometer/commercially available kits.
11. Evaluation of effects of antihistaminic drugs on the histamine-induced bronchospasm in guinea pigs using interactive simulated experiment.
12. To study and analyse drug-drug interaction/ rational drug management of asthma with the help of Case Study/ hypothetical data/ any clinical report.
13. To study clinical pharmacology of the plasma volume expanders and their importance (using charts/open sources videos).
14. Demonstration of evaluation of anti-inflammatory activity in paw oedema model using plethysmometer using simulations.
15. Concept of Biobanking and its significance in drug screening.
16. Isolation of Polymorphonuclear cells from blood and evaluation of endotoxin-induced oxidative stress in them using Nitrobluetetrazolium dye method by colourimetry.
17. Determination of viability of cells (using isolated polymorphonuclear cells) by Trypan blue dye exclusion assay to determine cell viability using microscopy method.
18. Determination of anti-inflammatory activity of durgs in vitro using RBC membrane stabilization assay
19. Determination of protein concentrations using Bradford reagent and plotting of standard curve of bovine serum albumin.
20. Estimation of anticholinesterase inhibitory activity of drugs using Ellman's reagent (DTNB)
21. Determination and and plotting of standard curve for LPO, Nitric oxide and GSH.
**PCI recommended software's shall be used for performing experiments.*

Recommended References (Preferably latest editions):

1. Ghosh, M. N. *Fundamentals of Experimental Pharmacology.* Hilton & Company.
2. Hofmann, F. B. Handbook of Experimental Pharmacology (HEP Series). Springer Nature.
3. *Computer Assisted Learning (CAL) software packages for experimental pharmacology simulations.*

Course Code	Course Title		Course Type
BP411I	**Internship**		**Internship**
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	--	--	8
Maximum Marks	SE		ESE
100	--		100

Appendix I

List of Recommended Electives (AEC/SEC/VAC courses to be prescribed by HEI)

Semester	Elective	Course Code	Course Title	Type	Category
II	Elective 1	BP212P SEC1	Communication Skills	Practical	SEC
		BP212P SEC2	Mental Well-Being, Stress & Conflict Management	Practical	SEC
		BP212P SEC3	Fundamentals of Computer Operations	Practical	SEC
III	Elective 2	BP312P AEC1	Nutraceuticals and Functional Foods	Practical	AEC
		BP312P AEC2	Food Analysis	Practical	AEC
		BP312P AEC3	Yoga and Life Sciences	Practical	AEC
VI	Elective 3	BP607T AEC1	Green Chemistry	Theory	AEC
		BP607T AEC2	Materiovigilance and Hemovigilance	Theory	AEC
		BP607T AEC3	Scientific Writing	Theory	AEC
		BP607T AEC4	Drug Store and Business Management	Theory	AEC
		BP607T AEC5	Career Building in Cultivation of Medicinal Plants	Theory	AEC
		BP607T AEC6	Active Pharmaceutical Ingredients and Excipient Sciences	Theory	AEC
	Elective 4	BP610P SEC1	Computer Aided Drug Design	Practical	SEC
		BP610P SEC2	Analytical Method Development and Validation	Practical	SEC
		BP610P	Principles of Preclinical Studies	Practical	SEC

SEMESTER III

Course Code	Course Title			Course Type
BP312P AEC1	**Nutraceuticals and Functional Foods (Practical)**			Elective
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	2	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are to:

1. Introduce the concept and classification of nutraceuticals and functional foods.
2. Explore the role of bioactive components in health promotion and disease prevention.
3. Familiarize students with the formulation, labelling, and quality control of nutraceuticals.
4. Understand the regulatory aspects governing nutraceuticals and dietary supplements.
5. Develop practical skills in extraction, analysis, and preparation of functional foods.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Classify and explain the functions of various nutraceuticals and functional foods.
2	Identify sources of important phytochemicals and dietary bioactives.
3	Perform basic laboratory techniques for nutraceutical product development.
4	Analyze labels and evaluate quality and efficacy of marketed supplements.
5	Understand regulatory frameworks (FSSAI, FDA, EFSA) and apply them in practice.

Detailed Syllabus

List of practical
(Perform any 12 Experiments) 1. Identification and classification of nutraceuticals and functional foods from marketed products 2. Preparation of a probiotic drink or yogurt using lactic acid bacteria 3. Extraction of phytochemicals (flavonoids, alkaloids) from plant material 4. Estimation of antioxidant activity using DPPH method 5. Formulation of a herbal supplement capsule or powder 6. Demonstration of dietary fiber content from cereals or vegetables 7. Assessment of total polyphenol content using Folin–Ciocalteu reagent 8. Label analysis of functional foods and dietary supplements (FSSAI standards)

9. Case study presentation: Role of omega-3 fatty acids in cardiovascular health
10. Demonstration of stability testing of a nutraceutical formulation
11. Preparation of fortified food product (e.g., iron-fortified juice)
12. Visit to a food testing laboratory or nutraceutical industry (or virtual tour)
13. Evaluation of glycemic index of selected carbohydrate-rich foods (conceptual)
14. Regulatory comparison of nutraceutical guidelines (FSSAI vs. FDA vs. EFSA)
15. Preparation of a functional food label with nutrition facts and claims

Recommended References *(Preferably latest edition)*:

1. Functional Foods: Concept to Product by M. Guo, Woodhead Publishing (Elsevier)
2. Handbook of Nutraceuticals and Functional Foods by Robert E.C. Wildman, CRC Press (Taylor & Francis Group)
3. Nutraceuticals and Functional Foods in Human Health and Disease Prevention by Debasis Bagchi, CRC Press (Taylor & Francis Group)
4. Functional Foods and Nutraceuticals: Sources and their Development Techniques by Rotimi E. Aluko, Springer Nature
5. Dietary Supplements and Nutraceuticals: Market, Regulations and Health Impacts by Yashwant Pathak, Academic Press (Elsevier)

Course Code	Course Title			Course Type
BP312P AEC2	**Food Analysis (Practical)**			Elective
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	2	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The primary objectives of this course are:

1. Understand to perform proximate analysis.
2. Know to operate, maintain, interpret and evaluate the data of instruments.
3. Understand and apply quality control principles.
4. Know to detect and analyze Food adulteration.
5. Knew to nutritional and quality aspects of food products

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to:
1	Gain knowledge on nutritional and quality aspects of food products.
2	Understand troubleshoot common issues of instruments.
3	Execute and apply theoretical knowledge of food chemistry.
4	Understand the various analytical techniques for qualitative and quantitative analysis.
5	Understand the significance and application of food analysis in ensuring safety and quality.

Detailed Syllabus

List of practical
(Perform any 12 Experiments) 1. Determination of the acid value for the given oil/fat 2. Determination of the ester value of the given oil/fat 3. Determination of the saponification value of the given oil/fat 4. Determination of total and free acidity in honey as per FSSAI method. 5. Quantification of caffeine content in soft drinks. 6. Determination of fat content in milk by gravimetric method 7. Detection of starch and urea in milk as per FSSAI method. 8. Assessment of fluoride content in drinking water 9. Assessment of total hardness in drinking water 10. Determination of the rancidity of the oil by UV Visible spectrophotometer 11. Quantification of benzoic acid as preservative in beverages/jam/ jellies by titrimetric/spectrophotometric method. 12. Isolation and identification of synthetic food colours by paper chromatography/Thin layer chromatography. 13. Determination of total curcuminoid content in turmeric by UV visible spectrophotometer. 14. Assessment of the total ash content for spices and condiments. 15. Determination of gluten content in whole wheat/wheat flour. 16. Determination of alcoholic acidity in bread and bread products. 17. Determination of Caloric value of food and nutritional supplements.
Recommended References (Preferably latest edition): 1. Food Analysis – Suzanne Nielsen, Springer 2. Introduction to Food Analysis – S. Suzanne Nielsen, Springer 3. Food Analysis: Theory and Practice – Y. Pomeranz & Clifton E. Meloan, Springer 4. Manual of Methods of Analysis of Foods – Food Safety and Standards Authority of India (FSSAI), Government of India 5. Food Chemistry – H.-D. Belitz, Werner Grosch & Peter Schieberle, Springer

Course Code	Course Title			Course Type
BP312P AEC3	**Yoga and Life Sciences (Practical)**			Elective
Credit	Hours Per Week (L-T-P)			Max. Hours
	L	T	P	
1	--	--	2	30
Maximum Marks	SE			ESE
50	20			30

COURSE OBJECTIVES:

The objectives of this course are:

1. To introduce students to the principles of yoga and its scientific basis.
2. To teach the practical aspects of yoga, including asanas (postures), pranayama (breathing exercises), and meditation.
3. To enhance students' understanding of the health benefits of yoga on physical and mental well-being.
4. To explore the role of yoga in the prevention and management of diseases.
5. To encourage a holistic lifestyle by incorporating yoga into daily routines.

COURSE OUTCOMES (CO):

CO No.	Upon successful completion of this course, the students will be able to
1	Perform basic yoga postures (asanas) and breathing exercises (pranayama).
2	Understand the physiological and psychological benefits of yoga.
3	Apply yoga techniques for stress relief, flexibility, and mental clarity.
4	Recognize the therapeutic potential of yoga in managing chronic health conditions.
5	Integrate yoga into daily life for improved well-being and productivity.

Detailed Syllabus

List of practical
(Perform any 12 Experiments) 1. Demonstration and practice of Surya Namaskar (Sun Salutation) 2. Practice of basic asanas: Tadasana, Vrikshasana, Bhujangasana 3. Practice of Pranayama techniques: Nadi Shodhana, Bhramari 4. Meditation session: Focused awareness and breath control 5. Yoga-based stretching and warm-up routine 6. Recording physiological parameters (heart rate, BP) before and after yoga 7. Yoga journal: Track weekly yoga practice and mood changes 8. Poster presentation on "Scientific benefits of yoga on immunity" 9. Yoga for specific health conditions: Back pain, asthma, stress 10. Group chanting of Mantra – observation of mental state 11. Learning the role of yoga in circadian rhythm regulation 12. Visit to a yoga wellness center or attending a virtual session 13. Assessment of flexibility using sit-and-reach test before/after practice 14. Demonstration of Yog Nidra (guided relaxation technique) 15. Case presentation: Impact of yoga on a chronic disease condition
Recommended References (Preferably latest edition): 1. Light on Yoga by B. K. S. Iyengar – A comprehensive guide to yoga postures and philosophy. 2. The Heart of Yoga by T. K. V. Desikachar – Explains principles and therapeutic applications of yoga. 3. Asana Pranayama Mudra Bandha by Swami Satyananda Saraswati – A classical reference on yogic practices and breathing techniques. 4. Ministry of AYUSH. Yoga Education and Practice Guidelines. Government of India. 5. World Health Organization. Traditional Medicine Strategy and integrative health resources.

Appendix II-Laboratory Specifications

1. Requirements of Laboratory Specifications

Sl No.	Particular	Details
1.	Lab Size	Total area: 75 Sq. mts including preparation room Capacity: 20–30 students + 1or 2 faculty
2.	Zoning (recommended)	1. Working benches (students) 2. Instructor/demo area 3. Instrument and balance zone 4. Fuming chamber (Chemistry Lab) and exhaust zone 5. Wash and drainage zone 6. Circulation
3. Floor Design and Specifications (Material): Acid- and alkali-resistant vitrified tiles/stone (heavy duty) or Epoxy resin flooring (chemical resistant, seamless)		
	Floor Specifications	1. Thickness: ≥10 mm (tiles) / 2–3 mm epoxy 2. Finish: Matt / anti-skid 3. Chemical resistance: Acids, alkalis, solvents, salts 4. Skirting:100–150 mm epoxy or tile skirting (covered)
	Sink and Drainage Layout	One sink per six students Sink material: Chemical Resistant with acid-resistant valves
	Drainage System	Separate lab drainage line (Discharge should be suitably treated for minimizing the Environmental impact)
4. Modular Furniture Layout		
	Student Working Benches	Type: Island benches Surfaces should be sufficiently chemical resistant
	Side Wall Benches	For instruments, reagent prep, drying
	Storage	Separate flammable storage cabinet (recommended)
5. Fuming Chamber (Fume Hood) Mandatory for Synthetic Chemistry Lab		
	Quantity	Minimum one
6. Exhaust and Ventilation System		
	General Ventilation	Wall-mounted exhaust fans Labs should be well ventilated.
	Exhaust Fans	Should be placed in every lab. Acid-resistant coating Placed near fuming chamber zone
7. Lighting and Electrical (Brief)		
	Lighting	300–500 lux at bench level Emergency lighting near exits Arrangement of sufficient lighting at the work benches in HAP and Pharmacognosy Lab.
	Electrical	Sufficient number of combination sockets on side benches:

		On benches sufficient number of electrical sockets (Earthing mandatory)
8. Preparation Room (Between Two Labs)		
	Location and Purpose	Preparation room with minimum 10 sq.mt area Each laboratory should have a preparation room. However, one preparation room may be shared by two laboratories if it is located between them and both belong to the same department used for Solution preparation, Reagent storage, Sample weighing
	Design Features	Central working bench Storage cabinets (lockable) Balance table (anti-vibration) Exhaust fan Chemical-resistant floor and walls (same specs as lab)
	Access	Door from both labs (controlled access) if shared.
9. Safety Provisions (Must-Have)		
		First aid box Material Safety Data Sheet (MSDS) display Proper signage Emergency eye wash and safety shower (near wet and fume hood zones) (Desirable) Fire Extinguisher (Dry Powder Type) Provision of Double Door Access (Every Laboratory)
10.	**Balance Room**	A closed balance room is desirable for housing high-sensitivity balances to prevent disturbances caused by airflow.
11.	**Gas Connection**	A gas connection is essential in the Pharmaceutical Chemistry, Pharmacognosy, and Pharmaceutics laboratories. One Bunsen burner may be shared by two students during practical sessions.

2. Department wise List of Minimum laboratory required for the B. Pharm as per NEP2020.

Sl No	Department	Laboratory Name	Area Requirement
1	Pharmaceutics	1. Fundamental Pharmaceutics Lab 2. Advanced Formulation Development Lab 3. Pharmaceutical Biotechnology and Microbiology lab (Including Aseptic Room)	75 Sq. mts including preparation room with minimum 10 sq.mt area Each laboratory should have a preparation room. However, one preparation room may be shared by two laboratories if it is located between them and both belong to the same department.
2	Pharmaceutical Chemistry	1. Inorganic and Analytical Chemistry 2. Synthetic Chemistry 3. Biochemistry and Biomedical Chemistry	
3	Pharmacology	1. Human Anatomy and Physiology 2. Pharmacology	
4	Pharmacognosy	1. Pharmacognosy Lab	

5	Research Lab	75 Sq. mts
6	Central Instrumentation Lab	80 Sq.mts with A/C Air purifier (desirable)
7	Machine Room	75-100 Sq.mts
8	Computer Lab	75 Sq mts
9	Store-I	100 Sq.mts
10	Store-II (For Inflammable chemicals)	20 Sq.mts

3. Department wise List of Minimum laboratory required for the B. Pharm as per NEP2020 and D. Pharm

Sl No	Department	Laboratory Name	Area Requirement
1	Pharmaceutics	1. Fundamental Pharmaceutics Lab 2. Advanced Formulation Development Lab 3. Pharmaceutical Biotechnology and Microbiology lab (Including Aseptic Room)	75 Sq. mts including preparation room with minimum 10 sq.mt area Each laboratory should have a preparation room. However, one preparation room may be shared by two laboratories if it is located between them and both belong to the same department.
2	Pharmaceutical Chemistry	1. Inorganic and Analytical Chemistry 2. Synthetic Chemistry 3. Biochemistry and Biomedical Chemistry	
3	Pharmacology	1. Human Anatomy and Physiology 2. Pharmacology 3. Social Pharmacy Lab	
4	Pharmacognosy	1. Pharmacognosy Lab	
5	Research Lab		75 Sq. mts
6	Central Instrumentation Laboratory		80 Sq.mts with A/C Air purifier (desirable)
7	Machine Room		75-100 Sq.mts
8	Computer Laboratory		75 Sq mts
9	Running Model Community Pharmacy		80 Sq. mts (Including 10 Sq. mt for Drug Information Centre & 10 Sq. mt. for Patient Counseling)
10	Store-I		100 Sq.mts
11	Store-II (For Inflammable chemicals)		20 Sq.mts

4. Laboratory Equipment and Apparatus

4.1. Pharmaceutics:

Sl. No	Instrument Name	Quantity
1.	Antibiotic Zone reader	1
2.	Autoclave	1

3.	Binocular Microscope (With Phase Contrast)	1
4.	BOD Incubator	1
5.	Buchner Funnels (Small, medium, large)	5 each
6.	Bulk Density & Tapped density Apparatus	2
7.	Burette & Burette stand	10 each
8.	Capsule counter	1
9.	Centrifuge (minimum 4000 rpm)	1
10.	Compound Microscope with movable stage	15
11.	Culture Tubes	30
12.	Deep freezer (Desirable)	1
13.	Desiccator (Glass/PVC)	5
14.	Digital Balance (min. 10mg)	4
15.	Digital Colony Counter	1
16.	Digital Melting point Apparatus	2
17.	Digital pH meter	3
18.	Digital Vernier calliper (Desirable)	4
19.	Distillation Unit	2
20.	Electronic Water Bath 12 Holes	3
21.	ELISA Reader and Kits (Desirable)	1
22.	Eye Piece Micrometer	10
23.	Franz Diffusion Cell (Desirable)	5
24.	Hardness Test apparatus (Monsanto & Pfizer)	2 each
25.	Heating Mantle (500ml)	10
26.	High Speed Homogenizer with RPM Controller and Display	5
27.	Hot Air Oven	3
28.	Hot Plate	4
29.	Glass Petri Plates/Casting Plates	10
30.	Incinerator	1
31.	Incubator (Desirable)	1
32.	Lab Fermenter (Desirable)	1
33.	Laminar Air Flow	1
34.	Magnetic Stirrer (500 ml) with Temperature Control	12
35.	Mechanical stirrer with propeller type agitator	2
36.	Mechanical Stirrer with Speed Regulator	8
37.	Membrane Filtration Unit	2
38.	Micro-centrifuge	1
39.	Micropipettes (1-10 µL, 10-100 µL, 100–1000 µL)	1 set
40.	Microscope with digital camera eyepiece (Desirable)	1
41.	Mortar & Pestle (Glass)	10
42.	Mortar Pestle (Porcelain)	20
43.	Ointment slab	10
44.	Ointment spatula	10
45.	Orbital Shaker Incubator	1

46.	Orbital Shaker/Flask Shaker (6 flask holding capacity) (Desirable)	2
47.	Ostwald viscometer	15
48.	Personnel Protection Equipment (Complete Set) (Desirable)	Adequate
49.	Petri Plates	30
50.	Platinum Inoculating Loop	30
51.	Pycnometer (Specific gravity Bottle)	30
52.	Refrigerated centrifuge	1
53.	Refrigerator	1
54.	Standard sieves, sieve no. 8, 10, 12,22,24, 44, 66, 80 (as per BIS standards)	1 Set
55.	Separating Funnel	10
56.	Spirit Lamps (Desirable)	10
57.	Stage micrometer	10
58.	Stalagmometer	15
59.	Sterility Testing Unit	1
60.	Stopwatch	5
61.	Suppository Mold	20
62.	Tablet counter	1
63.	Thermometer (Upto 300'C)	20
64.	Sonicator	1
65.	Vaccum Filtration Unit (Filtration Unit and Vaccum Pump)	2
66.	Vortex Shaker	2
67.	Water Bath (Copper)	10

4.2. Pharmaceutics Chemistry

Sl. No	Instrument Name	Quantity
1.	Boiling point apparatus (Desirable)	2
2.	Bomb Calorimeter (Desirable)	1
3.	Burette	60
4.	Centrifuge (12–16 tube capacity)	1
5.	Clinical Thermometer	10
6.	Digital Colorimeter	2
7.	Compound Microscope	5
8.	Digital potentiometer	1
9.	Desiccator	4
10.	Digital balance (10mg sensitivity)	3
11.	Digital Conductivity meter	1
12.	Digital Flame Photometer	1
13.	Digital Fluorimeter	1
14.	Digital pH meter	3
15.	Double door Refrigerator	2
16.	Fluoride ion meter (Desirable)	1
17.	Distillation Assembly (Glass)	1
18.	Double Distillation Assembly (Glass)	1

19.	Distillation Assembly (Steel- Wall Mounted))	1
20.	Fume hood	1
21.	Glass filtration assembly with 5 micron membrane filter	1
22.	Arsenic Test Apparatus (Gutzeit) apparatus	20
23.	Heating mantle (1000ml)	10
24.	Heating mantle (500 ml)	10
25.	Homogenizer	1
26.	Hot air oven	3
27.	Hot Plate	5
28.	Incubator (37°C) (Desirable)	1
29.	Ion exchanger	1
30.	Laboratory Microwave Oven (Desirable)	1
31.	Digital Melting Point apparatus	2
32.	Melting point apparatus (analog)	5
33.	Laboratory Thermometer	10
34.	Micropipettes (1-10 µL, 10-100 µL, 100–1000 µL)	1 set
35.	Magnetic stirrer with thermostat (1000ml)	5
36.	Magnetic stirrer with thermostat (500ml)	5
37.	Morter and pestle (500ml)	5
38.	Morter and pestle (Glass-250ml)	10
39.	Nessler cylinder	20 pairs
40.	Reflux flask and condenser double / triple necked	20
41.	Reflux flask and condenser single necked	20
42.	Sahli's Hemoglobinometer	15
43.	Soxhlet Apparatus (500mL)	2
44.	Stopwatch	10
45.	Vaccum pump	3
46.	TLC chamber	5
47.	UV cabinet	1
48.	Vortex Mixer (Desirable)	1
49.	Water bath with thermostat (6 holes)	3

4.3. Pharmacology:

Sl. No	Instrument Name	Quantity
1.	Adult CPR Manikin	2
2.	AED Trainer (Automated External Defibrillator) non-shocking version	1
3.	AED Trainer (Training Pads)	10
4.	Ambu Bag (Bag-Valve-Mask Resuscitator)	2
5.	Digital balance (10 mg sensitivity)	1
6.	Aneroid sphygmomanometer	5
7.	Arm Mannequin (Training Arm Model)	2
8.	Autoclave	1
9.	Barrier Devices	1
10.	Bio safety Cabinet (Class II) (Desirable)	1

11.	Biohazard Sharps Container	5
12.	Biohazard Waste Bag	1
13.	BMI Chart	Adequate
14.	Bones (set of spare bones)	1 set
15.	Centrifuge	1
16.	Charts for different organs, systems, tissues	Adequate
17.	Charts for family planning devices, contraception (birth control) methods, etc.	One for each
18.	Clinical thermometer (Digital)	10
19.	Clinical thermometer (Mercury)	10
20.	CO2 Incubator (Desirable)	1
21.	Colorimeter	1
22.	Compound Microscope	20
23.	Contraceptive devices including contraceptive pills (different types), male condom, female condom, diaphragm, copper-T, vaginal ring,	1 set
24.	Different Wound Dressing Materials	Adequate
25.	Digital blood pressure monitor	5
26.	Digital Glucometer with Test Strips	5
27.	Digital Hemoglobinometer with Test Strips	5
28.	Electrocardiograph (ECG Machine) (Desirable)	1
29.	Eye Occluder	10
30.	First Aid Kit	5
31.	Gauze Pads	20
32.	Hemocytometer (Neubauer's Chamber) with RBC/WBC Dilution Pipette	15
33.	Health promotion material (Charts, Pamphlets)	Adequate
34.	Hematology Analyzer (Desirable)	1
35.	Histopathological slides from toxicity studies	Adequate
36.	Homogenizer	2
37.	Hot plate	2
38.	Immunization chart	Adequate
39.	Incubator	1
40.	Infant/Child CPR Mannequin (Desirable)	1
41.	Infrared Thermometer	2
42.	Kneeling Pads	1
43.	Leaflet on lifestyle modifications for disease prevention.	Adequate
44.	Magnetic stirrer with hot plate	2
45.	Magnifying glass	10
46.	Masked patient reports (if available)/ theoretical case studies (at least one for each disease - anaemia, thalassemia, haemophilia, leprosy, gout, hypertension and ischemic heart disease, IBD, peptic ulcer, jaundice, hepatitis, typhoid, asthma, tuberculosis, diabetes, and thyroid disorders)	3 per diseases
47.	Measuring Tape	5
48.	Mechanical mixer	2

49.	Mercury sphygmomanometer	10
50.	Micropipettes (various ranges)	1 set
51.	Model for each organ system	1 Model for each organ system
52.	Mortar and pestle	5
53.	Peak Flow meter	10
54.	Pen torch	10
55.	Permanent Slides for various tissues (Epithelial tissue, Connective tissue, Muscle tissue, and Nervous tissue)	At least 30
56.	Personal Protective Equipment (PPE)	2
57.	pH meter	1
58.	Pocket Mask (CPR Mask)	2
59.	Pregnancy detection kit.	1 unit
60.	Pulse Oximeter	10
61.	Reflex hammer	10
62.	Refrigerator	1
63.	Sahli's Haemoglobinometer	20
64.	Skeleton	1
65.	Snellen Chart	2
66.	Specimen for various organs	15
67.	Spirometer	5
68.	Spirometer (digital)	1
69.	Stadiometer	2
70.	Stethoscope	15
71.	Stopwatch	10
72.	Student Organ Bath Complete Set up [Organ Bath assembly Single/Double unit, Sherrington Rotating Drum, Aretor, Different types of lever (Simple lever, Frontal writing lever, Starling's heart lever, Universal lever), Fulcrum, Stylus, Different types of Cannula (Arterial cannula, Venus cannula, Tracheal cannula), Clamp] **(For demonstration)**	2 set
73.	Suturing Practice Kit inclusing suturing pad (i.e. Surgical scissors, Tissue forceps, Suture needles, Suture thread, suturing pads)	10 sets
74.	Tuning fork (128 Hz)	10
75.	Two-point discriminator	5
76.	Vaccine Carrier (Desirable)	2
77.	Vortex mixer	1
78.	Water bath (at least 6 holes)	2
79.	Weighing Scale (Weighing balance upto 150 kg)	2
80.	Westergren Stand and Tube	15
81.	Wintrobe Tube and Stand	15
82.	Digital urine analyzer (Desirable)	1

4.4. Pharmacognosy

Sl. No	Instrument Name	Quantity
1.	Angle of Repose Apparatus (Desirable)	1
2.	Autoclave	1
3.	BOD incubator	1
4.	Buchner Funnel with Vacuum Pump	1
5.	Burette	30
6.	Camera lucida	10
7.	Centrifuge	1
8.	Clevenger apparatus (500ml;1L)	2sets each
9.	Column for chromatography	5 different size
10.	Compound Microscope	20
11.	Culture Bottles	10
12.	Culture flask	10
13.	Culture tubes	30
14.	Cutter Mill	1
15.	Desiccator	1
16.	Digital balance	1
17.	Digital microscope (Desirable)	1
18.	Double distillation unit (Desirable)	1
19.	Eyepiece/Ocular micrometer	20
20.	Germination Chamber (Desirable)	1
21.	Heating mantle	10
22.	Homogenizer	1
23.	Hot air oven	1
24.	Hydrometer Cylinder (Desirable)	5
25.	Liebig Condenser	15
26.	Magnetic Stirrer with hot plate	5
27.	Magnifying lens	30
28.	Micropipettes (1-10 µL, 10-100 µL, 100–1000 µL)	1 set
29.	Microtome (Desirable)	1
30.	Moisture balance	1
31.	Mortar and Pestle	15
32.	Muffle furnace	1
33.	pH meter	1
34.	Power Blender (Desirable)	1
35.	Projection microscope	2
36.	Pycnometer	5
37.	Reflux apparatus (Full setup)	15
38.	Refrigerator	1
39.	Rotary vaccum evaporator (Desirable)	1
40.	Separating funnel (250ml;500ml)	5 sets each
41.	Separating funnel (250ml;500ml)	5 sets each
42.	Sieve sets (40-60 mesh)	2 sets

43.	Silica crucible	10
44.	Simple distillation unit	1
45.	Soxhlet apparatus (Full set) (500ml; 1L)	2 sets each
46.	Spirit Lamp	30
47.	Stage micrometer	15
48.	Stereo microscope	2
49.	Sterility testing unit	1
50.	Stop watch / timer	2
51.	Test tube rack (10 slot)	5
52.	Thermometer (300 Centigrade)	15
53.	TLC chamber	10
54.	TLC glass slides	30
55.	TLC spreader	5
56.	TLC Spray bottle	5
57.	Tongs	15
58.	Sonicator	1
59.	UV Chamber (254 & 366 nm) (Desirable)	1
60.	Vernier Caliper (Desirable)	5
61.	Water bath (6holes)	2
62.	Weighing bottles with lid (Desirable)	15

4.5. Central Instrumentation Laboratory

Sl. No	Instrument Name	Quantity
1.	Autoanalyzer/Semi-autoanalyzer (Desirable)	1
2.	Conductivity Meter	1
3.	Cooling Sonicator (Desirable)	1
4.	Digital balance (1 mg sensitivity)	1
5.	Digital pH meter	1
6.	Disintegration Test Apparatus	1
7.	Dissolution test Apparatus	1
8.	Fluorimeter	1
9.	Friability Test Apparatus	1
10.	FTIR (Desirable)	1
11.	Gel Electrophoresis Unit (Desirable)	1
12.	High Performance Rotational Viscometer	1
13.	HPLC	1
14.	HPTLC (Desirable)	1
15.	Lyophilizer (Desirable)	1
16.	Refractometer	1
17.	Solid Phase Extraction apparatus (Desirable)	1
18.	Texture analyzer (Desirable)	1
19.	UV spectrophotometer	1
20.	UV Transilluminator (For Gel Electrophoresis) (Desirable)	1
21.	RT- PCR (Essential before the commencement of fifth semester)	1

4.6. Machine Room

Sl. No	Instrument Name	Quantity
1.	All-purpose equipment with all accessories (*)	1
2.	Ampoule filling and sealing machine (Jet Burner) (Desirable)	1
3.	Ampoule washing machine (Desirable)	1
4.	Ball mill (*)	1
5.	Bottle Sealing Machine	1
6.	Bottle washing Machine	1
7.	Coating pan machine (*)	1
8.	Collapsible tube - Filling and Sealing	1
9.	Double cone blender (*)	1
10.	Granulator machine	1
11.	Liquid Filling Machine	1
12.	Ointment filling machine (Desirable)	1
13.	Rotary Tablet Punching Machine (min 8 Station)	1
14.	Sieve shaker	1
15.	Stability Chamber	1
16.	Tray Dryer	1
17.	Fluidize Bed Dryer (Desirable)	1
18.	Spray Dryer (Desirable)	1
19.	Rotary Flash Evaporator (Desirable)	1
20.	Twin Screw Extruder (Desirable)	1
21.	**Note (*):** Either the marked instruments or the All-purpose equipment with all accessories must be procured.	

- Desirable instruments listed may be procured by the institute or accessed through collaboration/MoU with research centers or interdisciplinary institutions.

- The requirements specified herein apply to institutions offering the B. Pharm programme under the NEP 2020 syllabus. Institutions conducting more than one programme may share the common facilities, infrastructure, laboratories, equipment's, and other resources between the programmes, provided that such sharing complies with the norms and standards prescribed by the Pharmacy Council of India (PCI) and is adequate for all programmes.



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