

**The Indian Pharmaceutical Association-Maharashtra State Branch's
Bombay College of Pharmacy-Autonomous**

Kalina, Santacruz (E), Mumbai 400 098

(Approved by AICTE, PCI and affiliated to University of Mumbai)

**Detailed Syllabus structure and
Syllabus for B.Pharm- PCI**

w.e.f. Academic year 2024-25

Table-I: Course of study for Semester I

Coursecode	Name of the course	No. of hours	Tutorial	Credit points
BP101T	HumanAnatomyandPhysiologyI–Theory	3	1	4
BP102T	PharmaceuticalAnalysisI–Theory	3	1	4
BP103T	Pharmaceutics I–Theory	3	1	4
BP104T	PharmaceuticalInorganicChemistry–Theory	3	1	4
BP105T	Communicationskills–Theory	2	-	2
BP106RBT BP106RMT	Remedial Biology/RemedialMathematics– Theory	2	-	2
BP107P	HumanAnatomyandPhysiology–Practical	4	-	2
BP108P	PharmaceuticalAnalysis I–Practical	4	-	2
BP109P	Pharmaceutics I–Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communicationskills–Practical	4	-	1
BP112RBP	RemedialBiology–Practical	4	-	1
Total		34/36^{\$}/40[#]	4	27/29^{\$}/30[#]

[#]Applicable ONLY for the students who have studied Mathematics/Physics/Chemistry at HSC and will be appearing for the Remedial Biology (RB) course.

^{\$}Applicable ONLY for the students who have studied Physics/Chemistry/Botany/Zoology at HSC and will be appearing for the Remedial Mathematics (RM) course.

Table-II: Course of study for Semester II

CourseCode	Nameofthecourse	No. ofhours	Tutorial	Creditpoints
BP201T	HumanAnatomyandPhysiologyII– Theory	3	1	4
BP202T	PharmaceuticalOrganic ChemistryI–Theory	3	1	4
BP203T	Biochemistry– Theory	3	1	4
BP204T	Pathophysiology– Theory	3	1	4
BP205T	ComputerApplicationsinPharmacy–Theory	3	-	3
BP206T	Environmentalsciences– Theory	3	-	3
BP207P	HumanAnatomyandPhysiologyII–Practical	4	-	2
BP208P	PharmaceuticalOrganicChemistryI–Practical	4	-	2
BP209P	Biochemistry– Practical	4	-	2
BP210P	ComputerApplications inPharmacy–Practical	2	-	1
Total		32	4	29

Table-III: Course of study for Semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP308P	Pharmaceutical Engineering – Practical	4	-	2
Total		28	4	24

Table-IV: Course of study for Semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III – Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I – Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
Total		31	5	28

Table-V: Course of study for Semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Industrial Pharmacy I – Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy and Phytochemistry II – Theory	3	1	4
BP505T	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Industrial Pharmacy I – Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP508P	Pharmacognosy and Phytochemistry II – Practical	4	-	2
Total		27	5	26

Table-VI: Course of study for Semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance – Theory	3	1	4
BP607P	Medicinal Chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
Total		30	6	30

Table-VII: Course of study for Semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis–Theory	3	1	4
BP702T	Industrial Pharmacy II–Theory	3	1	4
BP703T	Pharmacy Practice–Theory	3	1	4
BP704T	Novel Drug Delivery System–Theory	3	1	4
BP705P	Instrumental Methods of Analysis–Practical	4	-	2
BP706PS	Practice School	12	-	6
Total		28	5	24

Table-VIII: Course of study for Semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET- BP813ET	Elective I* + Elective II*	3+3	1+1	4+4
BP813PW	Project Work	12	-	6
Total		24	4	22

*Students may select any two electives from those listed in the Syllabus.

Program Outcomes (PO)

PO 1: Pharmacy Knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.

PO 2: Planning Abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO 3: Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO 4: Modern tool usage: Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO 5: Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and wellbeing.

PO 6: Professional Identity: Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO 7: Pharmaceutical Ethics: Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO 8: Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO 9: The Pharmacist and society: Apply reasoning informed by contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO 10: Environment and sustainability: Understand the impact of professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 11: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self- assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

SEMESTER

IBP101T

HUMANANATOMYANDPHYSIOLOGY-I(Theory)

45Hours

CourseObjectives:

To impart fundamental knowledge on the anatomy, physiology, and functions of the various systems of the human body.

CourseOutcomes:

The learners should be able to:

1. Explain the gross morphology, structure, and functions of various organs of the human body with respect to the level of

2. Explain the various homeostatic mechanisms and their imbalances of the lymphatic, nervous and cardiovascular systems in relation to the knowledge of the pathophysiology of diseases.
3. Discuss the composition and functions of blood, explain the process of haemostasis, and correlate the knowledge to haematological disorders.
4. Understand coordinated working pattern of different muscles and organs of each system.

Mapping CO-PO:

BP101T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	-	3	-	2	3	-	3
CO2	3	2	2	2	-	3	-	2	3	-	3
CO3	3	2	2	2	-	3	-	2	3	-	3
CO4	3	2	2	2	-	3	-	2	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
1	Introduction to human body • Definition and scope of anatomy and physiology • Levels of structural organization and body systems • Basic life processes, homeostasis	1
2	Cellular level of organization • Structure and functions of cell • Transport across cell membrane, cell division, cell junctions • General principles of cell communication: intracellular signaling pathway activation, extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine	2
3	Tissue level of organization • Structural and functional characteristics of following tissues: Epithelial, Connective, Nervous, Muscle	2
4	Integumentary system • Structure and functions of skin	2

Syllabus B.Pharm (PCI)



5	Skeletal system and Joints	8
	• Divisions of skeletal system • Types of bone, salient features, and functions of bones • Organization of skeletal muscle • Physiology of muscle contraction, neuromuscular junction • Structural and functional classification of joints • Types of joints, movements and its articulation	
6	Body fluids and blood	6

	• Body fluids • Composition and functions of blood • Hemopoiesis, formation of haemoglobin, anaemia • Mechanisms of coagulation • Blood grouping, Rh factors, transfusion, its significance • Leucopoiesis • Immunity: Basics and types • Disorders of blood, reticuloendothelial system	
7	Lymphatic system • Components and functions of lymphatic system • Lymphatic organs and tissues • Organization of lymph vessels • Formation and flow of lymph	3
8	Peripheral Nervous System • Classification of peripheral nervous system • Structure and functions of sympathetic and parasympathetic nervous system • Origin and functions of spinal and cranial nerves • Methods to measure electrical activity of brain	9
9	Structure and Function of following sensory organs and their disorders: • Eye • Ear • Tongue • Nose	5
10	Cardiovascular system • Functional anatomy of heart • Conducting system of heart, Cardiac cycle, Electrocardiogram (ECG) • Physiology of blood circulation, Functional anatomy of blood vessels • Blood pressure and factors regulating blood pressure, baroreceptors, chemoreceptors, vasomotor centre, humoral and neuronal control of blood pressure and circulation disorders of heart.	7
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Waugh A, and Grant A, Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
2. Tortora G.J. & Derrickson B, Principles of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey, 2016
3. Guyton A.C., Hall J.E., Textbook of Medical Physiology, 12th edition, W.B. Saunders Company, USA/Prism Books Ltd. India, 2010.
4. Mackenna B.R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.

5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, William and Wilkins, USA, 1995.
6. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
7. Mohan H., Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
8. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017.

BP102T PHARMACEUTICAL ANALYSIS (Theory)

45 Hours

Course Objectives:

This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.

Course Outcomes:

Upon completion of the course students shall be able to:

1. Analyse the different techniques used in pharmaceutical analysis, evaluate sources of errors in analytical chemistry and propose effective methods to minimise errors.
2. Understand the principle, techniques, and applications of volumetric titrations.
3. Comprehend the fundamental principles and steps involved in gravimetric analysis
4. Comprehend the fundamental principles, instrumentation, and various titration methods related to electrochemical techniques.
5. Apply mathematical concepts to solve numerical related to pharmaceutical analysis and including volumetric, gravimetric, and electrochemical analysis.

Mapping CO-PO:

BP102T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	1	-	3	3	1	3	-	3
CO2	3	2	3	1	-	3	3	1	3	1	3
CO3	3	2	3	1	-	3	3	1	3	1	3
CO4	3	2	3	1	-	3	3	1	3	-	3
CO5	3	3	3	1	-	3	3	1	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak), no correlation—

Unit	Details	Hours
------	---------	-------

1	(a) Pharmaceutical analysis-Definition and scope i) Different techniques of analysis (Instrumental and Non-Instrumental). ii) Methods of expressing concentration- Molarity, Molality, percent concentration, ppm, ppb, Normality, Numericals. iii) Primary and secondary standards. iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate. (b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision, Concepts and numerical of Mean, Median, Standard deviation, Relative standard deviation and Significant figures. (c) Pharmacopoeia-Introduction to Pharmacopoeial monographs and their significance (relevance of all the tests to be discussed), Sources of impurities in medicinal agents, limit tests.	10
2	(a) Titrations (Theoretical terms)-Titrimetric analysis, Titrant, Titrand, Theoretical end point or equivalence point, End point of titration, Titration error, Conditions for titrimetric analysis, Classification of reactions for titrimetric analysis. (b) Law of Mass Action, Equilibrium Constant, pH, pKa, pKb, hydrolysis of salts, Buffer solutions, Buffer Capacity, Numericals for pH calculation. (c) Acid base titration: Theories of acid base indicators (Ostwald's theory, Resonance theory), Mixed indicators, concept of range of indicators, Choice of indicators; Classification of acid base titrations and theory involved in titration of strong, weak, and very weak acids and bases, Neutralization curves; Method of titration (Direct titration, back titration, blank determination, Factor calculation for assays); Assay of benzoic acid. (d) Non-aqueous titration: Solvents (aprotic, protophilic, protogenic, amphiprotic), characteristics of solvents for non-aqueous titrations (acid-base character, dielectric constant, leveling and differentiating effect), Indicators for non-aqueous titrations, Acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.	10

3	(a) Precipitation titrations: Common Ion Effect, Solubility Product, Factors affecting solubility of precipitates, Fractional precipitation; Mohr's method, Volhard's, Modified Volhard's, Fajans method, Standardization of silver nitrate, Estimation of sodium chloride. (b) Complexometric titration: Terms- Complex, Complexing agents (Complexones), Chelate, Ligand, Co-ordination number, Chelating agent, Sequestering agent, Metal-ligand complex; Formation of complexes; Classification (Direct method, back titration, replacement titration), Metal ion indicators (pM indicators), masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate, Determination of mixture of lead, zinc and magnesium in a sample. (c) Gravimetry: Principle and steps involved in gravimetric analysis, Organic and inorganic precipitants, Purity of the precipitate: co-precipitation and post-precipitation, Ostwald's ripening, Degree of supersaturation (Von Weimarn ratio), Estimation of barium sulphate, Assay of Aluminium by oxine reagent. (d) Nitrite titrations: Basic Principles, methods and application of diazotisation titration, Concept of external indicator, Assay of Sulphacetamide sodium.	10
4	(a) Redox titrations i) Concepts of oxidation and reduction - Oxidising and reducing agents, Standard reduction potential, Nernst equation, Redox titration curve and Equivalence point. ii) Types of redox titrations (Principle, Titrants, Indicators and Application) – Permanganometry (Assay of hydrogen peroxide), Cerimetry (Assay of Paracetamol and Dried Ferrous sulphate), Iodimetry (Assay of Ascorbic acid API), Iodometry (Assay of potassium permanganate), Bromatometry (Assay of Isoniazid), Dichrometry (Iron), Titration with potassium iodate (Assay of Potassium iodide).	8
5	(a) Electrochemical methods of analysis i) Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications. ii) Potentiometry- Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrode and glass electrode), methods to determine end point of potentiometric titration (aqueous acid-base titrations - Strong acid vs strong base, strong acid vs weak base, weak acid vs strong base, weak acid vs weak base) and applications. iii) Polarography- Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, Current-Voltage curve (Polarogram), supporting electrolyte, Oxygen wave, polarographic maxima, factors affecting limiting current, half wave potential, applications, Pulse polarography-Normal pulse polarography, Differential pulse polarography and square wave polarography	7
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Beckett, A.H. and J.B. Stenlake. Practical Pharmaceutical Chemistry: Part I and

II, CBS Publishers and Distributors, India.

2. G.D.Christian, Analytical Chemistry, 6th edition, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd, 2003.
3. Connors, K. A., A Textbook of Pharmaceutical Analysis, 3rd edition, John Wiley and Sons, Canada, 2007.
4. Skoog, D. A., F. J. Holler and S. R. Crouch. Principles of Instrumental Analysis, 6th edition, Brooks/Cole, 2006
5. Skoog, D. A., and D. M. West. Fundamentals of Analytical Chemistry, 7th edition, Brooks/Cole, USA, 1995.
6. Watson, D. G. Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, Elsevier Health Sciences, London.
7. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.
8. Kar, A. Pharmaceutical Drug Analysis, New Age International India.
9. Mahajan S. S. Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd, India.
10. Chatwal, G. R., and M. Arora. Analytical Chemistry, Himalaya Publishing House.
11. Indian Pharmacopoeia, Indian Pharmacopoeia Commission, India.
12. Willard, H. H., L. Merritt, F. Settle and J. A. Dean. Instrumental Methods of Analysis, CBS Publishers & Distributors, India.
13. Ewing, G. W. Instrumental Methods of Chemical Analysis, McGraw-Hill Book Company, New York.
14. Robinson, J. W., E. M. S. Frame and G. M. Frame. Undergraduate Instrumental Analysis, Skelly Frame and G. M. Frame II, Publication.
15. Kellner, R., J. M. Mermet, M. Otto, M. Valcárcel and H. M. Widmer. Analytical Chemistry, John Wiley & Sons Australia, Limited.

BP103T

PHARMACEUTICS-I (Theory)

45 Hours

Course Objectives: This course is designed to impart fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Course Outcomes:

Upon completion of this course the student should be able to:

1. Know the history of profession of pharmacy, official compendia and different types of dosage forms.
2. Employ the knowledge of pharmaceutical calculations, pharmaceutical incompatibilities, parts and errors in prescription and posology for handling the prescription and dispensing of medications.
3. Summarize and compare the different formulation and evaluation aspects of pharmaceutical powders, monophasic liquids, biphasic systems, suppositories, and semisolids.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	1	3	3	1	2	1	3
CO2	3	1	3	2	1	3	3	2	3	1	3
CO3	3	1	3	2	1	2	2	1	1	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
1	Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. Dosage forms: Introduction to dosage forms, classification, and definitions Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription. Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	10
2	Pharmaceutical calculations: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent, and hygroscopic powders, eutectic mixtures. Geometric dilutions. Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques	10
3	Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Pain t, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. Biphasic liquids: Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. Emulsions: Definition, classification, emulsifying agents, tests for identification of type of Emulsion, Methods of preparation, stability problems and methods to Overcome	9
4	Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. Pharmaceutical incompatibilities: Definition, classification, physical, chemical, and therapeutic incompatibilities with examples.	9
5	Semisolid dosage forms: Definitions, classification, mechanisms, and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams, and gels. Excipients used in semisolid dosage forms. Evaluation of semisolid	7
	dosage forms	
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Wilkins, USA, 2014.
2. Carter S.J., Cooper and Gunn's - Dispensing for Pharmaceutical Students, 12th edition, CBS Publishers and Distributors, New Delhi, 2008.
3. Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.

4. Indian Pharmacopoeia.
5. British Pharmacopoeia.
6. Lachman, L., Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, 1st edition, Lea & Febiger, Philadelphia, 1986
7. Khar, R.K., Vyas, S.P., Ahmad F.J., Jain G.K., Lieberman, Lachman's - The Theory and Practice of Industrial Pharmacy, 4th edition, CBS Publishers and Distributors, New Delhi, 2020.
8. Gennaro A.R., Remington : The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, Philadelphia, 2005.
9. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publishers and Distributors Pvt. Ltd, Delhi, 2005.
10. Rawlins E.A., Bentley's Textbook of Pharmaceutics, 8th edition, Elsevier India, 2010.
11. Ghebre-Sellassie I., Pharmaceutical Pelletization Technology, 1st edition, Marcel Dekker, Inc., New York, 1990
12. Parikh D.M., Handbook of Pharmaceutical Granulation Technology, 1st edition, Marcel Dekker, Inc., New York, 1997.
13. Nieloud F and Gilbert M., Pharmaceutical Emulsions and Suspensions, 1st edition, Marcel Dekker, Inc., New York, 2000.

BP104T

PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

45 Hours

Course Objectives:

This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Course Outcomes:

Upon completion of the course the student shall be able to:

1. **Explain** the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.
2. **Apply** knowledge of major physiological ions and their functions, including the use of electrolytes such as sodium chloride, potassium chloride, calcium gluconate, and ORS in replacement therapy. Analyze the principles of physiological acid-base balance, considering various clinical scenarios and therapeutic applications.
3. **Understanding** of dental products, including dentifrices and desensitizing agents, and analyze the role of fluoride in treating dental caries. Evaluate the properties and applications of specific dental agents such as calcium carbonate, sodium fluoride, and zinc eugenol cement in dental care.
4. **Apply** knowledge and analyze the mechanisms of action, interactions, and potential side effects of antacids, and critically assess their effectiveness in managing gastrointestinal disorders, using appropriate antacids, acidifiers, cathartics, antimicrobial agents.
5. **Understand and Apply knowledge** of expectorants, emetics, haematinics, poisons, antidotes, and astringents, including the mechanisms of action, dosages, potential side effects, and therapeutic applications of specific substances, in pharmaceutical scenarios.
6. **Understand and Apply knowledge** of radioactivity, including the measurement of radioactivity and the properties of α , β , and γ radiations, to assess the characteristics and behaviour of radioactive substances.

Mapping CO-PO:

BP104T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11

Syllabus B.Pharm (PCI)



CO1	3	1	2	-	-	1	1	2	1	-	2
CO2	3	-	2	-	-	1	1	2	2	-	1
CO3	3	-	3	-	-	2	-	2	2	-	1
CO4	3	-	2	-	-	2	2	1	2	-	1
CO5	3	2	2	-	-	2	2	2	1	-	2
CO6	2	-	2	1	-	1	-	1	1	1	1

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak), no correlation –

Unit	Details	Hours
1	Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate General methods of preparation , assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes.	10
2	Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurement of tonicity, calculations, and methods of adjusting isotonicity. 1. Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid-base balance. 2. Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	10
3	Gastrointestinal agents Acidifiers: Ammonium chloride* and dil. HCl Antacid: Ideal properties of antacids, combination of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture. Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations.	10
4	Miscellaneous compounds Expectorants: Potassium iodide, Ammonium chloride*. Emetics: Copper sulphate*, Sodium potassium tartarate Haematinics: Ferrous sulphate*, Ferrous gluconate Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite Astringents: Zinc Sulphate, Potash Alum	8

5	Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radioisotopes and study of radioisotopes-Sodium iodide 131 , Storage conditions, precautions & pharmaceutical application of radioactive substances.	7
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970.
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951.
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013.
4. Bentley A.O., Atherden L.M., Driver J.E., Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York, and Toronto, 1945.
5. Kennedy J.H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, 1990.
6. Indian Pharmacopoeia.

BP105T

COMMUNICATIONS SKILLS (Theory)

30 Hours

Course Objectives:

This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists, and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Course Outcomes:

Upon completion of the course the student shall be able to:

1. Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non-verbal)
3. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

Unit	Details	Hours
1	Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context. 1. Barrier to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers. 2. Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment.	7

Syllabus B.Pharm (PCI)



2	1.ElementsofCommunication: Introduction,FacetoFaceCommunication-Tone of Voice, Body Language (Non-verbal communication), VerbalCommunication,PhysicalCommunicationforeach-DirectCommunicationStyle,Spirited Communication Style,Systematic Communication Style,ConsiderateCommunicationStyle.	7
3	BasicListeningSkills: Introduction,Self-Awareness,ActiveListening,BecominganActiveListener,ListeninginDifficultSituations. 1. Effective Written Communication: Introduction, When and When Not toUse Written Communication - Complexity of the Topic, Amount of Discussion'Required,ShadesofMeaning,FormalCommunication. 2. Writing Effectively: Subject Lines, Put the Main Point First, Know YourAudience,OrganizationoftheMessage.	7
4	InterviewSkills: Purposeofaninterview,Do's andDon'tsofaninterview 1. GivingPresentations: Dealing with Fears,planning yourPresentation,StructuringYourPresentation,DeliveringYour Presentation,TechniquesofDelivery.	5
5	GroupDiscussion: Introduction,Communicationskillsin groupdiscussion,Do'sandDon'tsofgroupdiscussion.	4
	TOTAL	30

ReferenceBooks(LatestEditionstobeadopted):

1. Rutherford A.J., Basic Communication Skillsfor Technology, 2nd Edition, Pearson Education, Delhi, 2011
2. SanjayKumar, Pushp lata, Communicationskills, 2nd Edition, Oxford Press, Lucknow 2015.
3. Robbins S.P., Organizational Behaviour, 1st Edition, Pearson, San Diego, USA, 2013.
4. Hasson G., Brilliant-Communicationskills, 1st Edition, Pearson Life, UK, 2011
5. Gopala S.W., The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson Education, Delhi, 2013.
6. Dalley D, Burton Lois, Greenhall M., Developing your influencing skills, 1st Edition Universe of Learning Ltd, Manchester, United Kingdom, 2010.
7. Konar N., Communication skills for Professionals, 2nd Edition, New arrivals – PHI Learning Pvt. Ltd, New Delhi, 2011.
8. Mitra, B.K., Personality development and soft skills, 1st Edition, Oxford Press, Lucknow, 2011.
9. Butterfield, J., Soft skill for everyone, 1st Edition, Cengage Learning India Pvt. Ltd, New Delhi, 2011.
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, New York, 2011.
11. Adair John, Effective communication, 4th Edition, Pan MacMillan, 2009.
12. Daniels A.C, Bringing out the best in people, 2nd Edition, McGraw Hill Education, New York, 1999.

BP106RBT

Remedial Biology(Theory)

30 Hours

Course Objectives:

To get the learner acquainted with the facets of biology in the plant and animal kingdom.

Course Outcomes:

The learners should be able to:

1. Understand the classification and features of plant and animal kingdom.
2. Know the anatomy and physiology of plants.
3. Appreciate the anatomy & physiology in animals especially the human body

BP106RBT Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	-	-	-	1	-	2	1	1
CO2	3	1	2	-	-	-	1	-	2	1	1
CO3	3	2	2	-	2	-	2	1	2	1	1

Unit	Details	Hours
	Living world: - Definition and characters of living organism - Diversity in the living world - Binomial nomenclature - Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus	5
2	Morphology of Flowering plants - Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed - General Anatomy of root, stem, leaf of monocotyledons & dicotyledons	2
3	Body fluids and circulation - Composition of blood, blood groups, coagulation of blood - Composition and functions of lymph - Human circulatory system - Structure of human heart and blood vessels	7
	- Cardiac cycle, cardiac output, and ECG - Digestion and Absorption - Human alimentary canal and digestive glands - Role of digestive enzymes - Digestion, absorption, and assimilation of digested food - Breathing and respiration - Human respiratory system - Mechanism of breathing and its regulation - Exchange of gases, transport of gases and regulation of respiration - Respiratory volumes	

4	Excretory products and their elimination • Modes of excretion • Human excretory system- structure and function • Urine formation • Renin-angiotensin system • Neural control and coordination Definition and classification of nervous system • Structure of a neuron • Generation and conduction of nerve impulse • Structure of brain and spinal cord • Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata Chemical coordination and regulation Endocrine glands and their secretions • Functions of hormones secreted by endocrine glands Human reproduction • Parts of female reproductive system • Parts of male reproductive system • Spermatogenesis and Oogenesis • Menstrual cycle	7
5	Plants and mineral nutrition • Essential mineral, macro, and micronutrients. • Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation. Photosynthesis • Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	5
6	Plant respiration • Respiration, glycolysis, fermentation (anaerobic) Plant growth and development. • Phases and rate of plant growth, condition of growth, introduction to plant growth regulators. Cell: The unit of life • Structure and functions of cell and cell organelle, cell division Tissues • Definition, types of tissues, location, and functions.	4
	TOTAL	30

Reference books (Latest Edition to be adopted):

1. Gokhale S.B, Kalaskar M.G, Kulkarni Y.A, Remedial Biology (Pharmaceutical Biology), 1st edition, Nirali Prakashan, Pune, 2017.
2. Seetharam P.L, Thulajappa Y, Chavan R.R, Textbook of Biology, 1st edition, Expert Educational Publishers, Bangalore, 1995.
3. Naidu B. V.S, Renukumar B.M, Textbook of Biology, 1st edition, Sri Renuka Publications, Davangere, 1972.
4. Naidu B. V.S, Murthy P.K, Textbook of Biology, 1st edition, Prakash Sahithye, Bangalore, 1972.
5. Dutta A.C, Botany for Degree students, 6th edition, MKM Publishers Pvt. Ltd, New Delhi, 1998.
6. Ayyar E.K; TN Anathakrishnan, A Manual of Zoology, 5th edition, S. Viswanathan Pvt. Ltd, Madras, 1992.

7. Gokhale S.B, Kalaskar M.G, Kulkarni Y.A, A Practical book of Remedial Biology, 1st edition, Nirali Prakashan, Pune, 2018.

BP106RMT
REMEDIAL MATHEMATICS (Theory) 30 Hours

Course Objectives:

This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. Know the theory and their application in Pharmacy
2. Solve the different types of problems by applying theory
3. Appreciate the important application of mathematics in Pharmacy

BP106RMT	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
Course Outcomes											
CO1	3	2	3	1	-	-	-	-	1	-	3
CO2	3	2	3	1	-	-	-	-	1	-	3
CO3	3	2	3	1	-	-	-	-	1	-	3

Unit	Details	Hours
1	Partial fraction Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics. 1. Logarithms Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. 2. Function: Real Valued function, Classification of real valued functions, 3. Limits and continuity: Introduction, Limit of a function, Definition of limit of a function (ϵ-δ definition), $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}, \quad \lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1,$	6
2	Matrices and Determinant: Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley-Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.	6

3	Calculus Differentiation: Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function, Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – Without Proof , Derivative of x^n w.r.t x , where n is any rational number, Derivative of e^x , Derivative of $\log_e x$, Derivative of a^x , Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application.	6
4	Analytical Geometry Introduction: Signs of the Coordinates, Distance formula, Straight Line: Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line. Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.	6
5	Differential Equations: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations. 1. Laplace Transform: Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations.	6
	TOTAL	30

Reference Books (Latest Edition to be adopted):

1. Shanti Narayan, Mittal P.K., Differential Calculus, revised edition, S. Chand and Co. Pvt. Ltd, New Delhi, 2013.
2. Panchaksharappa Gowda D.H., Pharmaceutical Mathematics with application to Pharmacy, 1st Edition, Pharma Med Press, 2014
3. Shanti Narayan, Mittal P.K., Integral Calculus, 11th edition, S. Chand and Co. Pvt. Ltd, 2013.
4. Grewal B.S., Higher Engineering Mathematics, 44th edition, Khanna Publishers, New Delhi, 2020.

BP107P

Human Anatomy and Physiology (Practical)

Course Objectives:

To get the learner acquainted with the diagnostic methods employed in detection of the pathology of some disease states.

Course Outcomes

The learners should be able to:

1. Perform hematology tests, record the heart rate, pulse and blood pressure and relate the results with clinical conditions.
2. Identify and postulate the position of the bones in human skeleton.
3. Identify and describe the various body tissues and organs based on the structure and organization of cells.

Mapping CO-PO:

Syllabus B.Pharm (PCI)



BP107P <i>Course Outcomes</i>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	3	3	2	2	3	3	2	3	-	3
CO2	3	3	3	2	2	3	3	2	3	-	3
CO3	3	3	3	2	2	3	3	2	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details
1	Study of compound microscope.
2	Microscopic study of permanent slides of tissues: Discussion on the normal as well as pathological changes with the help of charts/images. • Columnar, Cuboidal, Squamous, Ciliated Epithelium • Cardiac, Skeletal, Smooth muscle • Ovary, Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein
3	Study of bones: • Axial • Appendicular
4	Introduction to hemocytometry: Determination of the hematology studies and discussion of the pathological deviations from baseline values 1) Red Blood cell (RBC) Count 2) Total Leukocyte Count 3) Differential Leukocyte (WBC) Count 4) Haemoglobin content of blood 5) Bleeding/Clotting Time 6) Blood groups 7) Erythrocyte Sedimentation Rate (ESR)/ Hematocrit (Demonstration)
5	Determination of heart rate and pulse rate.
6	Recording of blood pressure.

Reference Books (Latest Editions to be adopted):

1. Mackenna B.R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
2. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
3. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
4. Ghai C.L., Textbook of Practical Physiology, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi
5. Mohan H., Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
6. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017.

BP108PPHARMACEUTI
CALANALYSIS(Practical)

Course Objectives: This course deals with the fundamentals of analytical chemistry and principles of titrimetry, turbidometry, electrochemical analysis and gravimetry.

Course Outcomes:

Upon completion of the course student shall be able to:

1. Demonstrate proficient preparation and dilution techniques to ensure accuracy of solutions for analysis.
2. Perform, record, calculate and interpret data obtained from volumetric analysis, gravimetric analysis, and electrochemical titrations.
3. Apply the principles of GLP in the laboratory to ensure data accuracy and compliance.

BP108P <i>Course Outcomes</i>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	1	3	3	2	3	1	3
CO2	3	3	3	3	1	3	3	2	3	1	3
CO3	3	3	3	3	1	3	3	2	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

I Preparation and standardization of-

- (1) Sodium hydroxide.
- (2) Sulphuric acid.
- (3) Sodium thiosulfate.
- (4) Potassium permanganate.
- (5) Cerium ammonium sulphate.

II Assay of the following compounds along with Standardization of Titrant-

- (1) Ammonium chloride by acid-base titration.
- (2) Ferrous sulphate by Cerimetry.
- (3) Copper sulphate by Iodometry/Sodium metabisulphite.
- (4) Calcium gluconate by complexometry.
- (5) Hydrogen peroxide by permanganometry.
- (6) Sodium benzoate by non-aqueous titration.
- (7) Sodium Chloride by precipitation titration.
- (8) Assay of Aspirin (Back titration).
- (9) Assay of Sulphacetamide sodium (Nitrite titration).
- (10) Assay of Ascorbic acid (Iodimetry).

III Determination of Normality by electro-analytical methods

- (1) Conductometric titration of strong acid against strong base.
- (2) Conductometric titration of strong acid and weak acid against strong base.
- (3) Potentiometric titration of strong acid against strong base.
- (4) Potentiometric titration of weak acid against strong base.

IV Gravimetric analysis

(1) Determination of Barium as Barium sulphate.

Reference Books (Latest Edition to be adopted):

1. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013
4. Bentley A.O., Atherden L.M., Driver J.E., Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York, and Toronto, 1945
5. Kennedy J.H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, Indian Pharmacopoeia
6. Christian, G.D., Dasgupta, P.K., Schug, K.A., Analytical Chemistry, 7th edition, Wiley India Pvt. Limited, 2013.
7. J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.

BP109P

PHARMACEUTICS -I (Practical)

Course Objectives:

This course is designed to impart fundamental knowledge for preparing selected conventional dosage forms.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Understand the basics of different dosage forms and pharmaceutical incompatibilities.
2. Solve different pharmaceutical calculations
3. Prepare some simple and conventional dosage forms.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP 109P CO1	3	1	2	1	1	3	3	2	3	1	3
BP 109P CO2	3	2	3	1	1	3	3	2	1	1	3
BP 109P CO3	3	3	3	2	2	3	3	2	2	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details
1	Syrups a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68
2	Elixirs a) Piperazine citrate elixir b) Paracetamol pediatric elixir
3	Linctus a) Terpin Hydrate Linctus IP'66

4	Solutions b) Iodine Throat Paint (Mandles Paint) a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution
5	Suspensions a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminum Hydroxide gel
6	Emulsions a) Turpentine Liniment b) Liquid paraffin emulsion
7	Powders and Granules a) ORS powder (WHO) b) Effervescent granules c) Dusting powder d) Divided powders
8	Suppositories a) Glycerogelatin suppository b) Cocoa butter suppository c) Zinc Oxide suppository
9	Semisolids a) Sulphur ointment b) Non-staining iodine ointment with methyl salicylate c) Carbopol gel
10	Gargles and Mouthwashes a) Iodine gargle b) Chlorhexidine mouthwash

Reference Books (Latest Edition to be adopted):

1. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Wilkins, USA, 2014.
2. Carter S.J., Cooper and Gunn's - Dispensing for Pharmaceutical Students, 12th edition, CBS Publishers and Distributors, New Delhi, 2008.
3. Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.
4. Indian Pharmacopoeia.
5. British Pharmacopoeia.
6. Lachman, L., Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, 1st edition, Lea & Febiger, Philadelphia, 1986
7. Khar, R.K., Vyas, S.P., Ahmad F.J., Jain G.K., Lieberman, Lachman's - The Theory and Practice of Industrial Pharmacy, 4th edition, CBS Publishers and Distributors, New Delhi, 2020.
8. Gennaro A.R., Remington: The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, Philadelphia, 2005.
9. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publishers and Distributors Pvt. Ltd, Delhi, 2005.
10. Rawlins E.A., Bentley's Textbook of Pharmaceutics, 8th edition, Elsevier India, 2010.
11. Ghebre-Sellassie I., Pharmaceutical Pelletization Technology, 1st edition, Marcel Dekker, Inc., New York, 1990
12. Parikh D.M., Handbook of Pharmaceutical Granulation Technology, 1st edition, Marcel Dekker, Inc., New York, 1997.

13. Nieloud Fand Gilberte M., Pharmaceutical Emulsions and Suspensions, 1st edition, Marcel Dekker, Inc., New York, 2000.

BP110P

PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

Course Objectives:

This course is designed to impart a fundamental knowledge for preparation of salts and testing the presence of different ions, salts, and their purity.

Course Outcomes:

Upon completion of this course the students should be able to:

1. **Demonstrate** the quality control tests in limiting traces of impurities present in pharmaceuticals by performing limit tests. Prepare some simple inorganic pharmaceuticals.
2. **Outline** the synthesis and evaluate the physical and chemical properties of inorganic compounds of medicinal interest.
3. **Identify** cations and anions present in the inorganic drugs.
4. **Apply** the pharmacopoeial methods for preparation of standard solutions of known concentration.
5. **Determine** the acid neutralizing capacity of antacid tablets.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP110P CO1	3	1	2	-	-	2	1	1	1	-	1
BP110P CO2	2	1	2	-	-	1	1	1	1	-	-
BP110P CO3	2	2	2	-	-	-	1	-	-	-	-
BP110P CO4	2	1	1	-	-	-	1	-	-	-	-
BP110P CO5	2	1	1	-	-	-	1	1	1	-	-

While mapping Course Outcomes (CO) with POs the degree of association is indicated as 3 (Strong), 2 (Moderate) and 1 (Weak), no correlation-.

I. Limit tests for following ions

Limit test for Chlorides and Sulphates
Modified limit test for Chlorides and Sulphates
Limit test for Iron
Limit test for Heavy metals
Limit test for Lead
Limit test for Arsenic

II Identification test

Magnesium
hydroxide
Ferrous sulphate
Sodium
bicarbonate
Calcium
gluconate
Copper sulphate

III Test for purity

Swelling power of Bentonite
Neutralizing capacity of aluminum hydroxide gel
Determination of potassium iodate and iodine in potassium Iodide

IV Preparation of inorganic pharmaceuticals

Boric

acidPotash
alumFerroussulp
hate

Reference Books (Latest Edition to be adopted):

1. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970.
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951.
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013.
4. Bentley A.O., Atherden LM, Driver J.E., Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York, and Toronto, 1945.
5. Kennedy J.H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, 1990.
6. Indian Pharmacopoeia.

BP111P COMMUNICATION SKILLS (Practical)

Course Objectives:

This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists, and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. Learn basic communication and pronunciation using English language lab software 'wordsworth'.
2. Develop writing and presentation skills

BP111P Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
BP111P CO1	3	1	1	-	2	3	1	3	1	-	3
BP111P CO2	3	1	1	-	2	3	1	3	1	-	3

While mapping Course Outcomes (CO) with POs the degree of association is indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

1. **Basic communication covering the following topics**
 - a. Meeting People
 - b. Asking Questions
 - c. Making Friends
 - d. What did you do?
 - e. Do's and Don't's
2. **Pronunciation covering the following topics**
 - a. Pronunciation (Consonant Sounds)
 - b. Pronunciation and Nouns
 - c. Pronunciation (Vowel Sounds)
3. **Advanced Learning**

- a. Listening Comprehension/Direct and Indirect Speech
- b. Figures of Speech
- c. Effective Communication
- d. Writing Skills
- e. Effective Writing
- f. Interview Handling Skills
- g. E-Mail Etiquette
- h. Presentation Skills

Reference Books (Latest Editions to be adopted):

1. Rutherford A.J., Basic Communication Skills for Technology, 2nd Edition, Pearson Education, Delhi, 2011
2. Sanjay Kumar, Pushplate, Communication skills, 2nd Edition, Oxford Press, Lucknow 2015.
3. Robbins S.P., Organizational Behaviour, 1st Edition, Pearson, San Diego, USA, 2013.
4. Hasson G., Brilliant-Communication skills, 1st Edition, Pearson Life, UK, 2011
5. Gopala S.W., The Art of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson Education, Delhi, 2013.
6. Dalley D, Burton Lois, Greenhall M., Developing your influencing skills, 1st Edition Universe of Learning Ltd, Manchester, United Kingdom, 2010.
7. Konar N., Communication skills for Professionals, 2nd Edition, New arrivals – PHI Learning Pvt. Ltd, New Delhi, 2011.
8. Mitra, B.K., Personality development and soft skills, 1st Edition, Oxford Press, Lucknow, 2011.
9. Butterfield, J., Soft skill for everyone, 1st Edition, Cengage Learning India Pvt. Ltd, New Delhi, 2011.
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, New York, 2011.
11. Adair John, Effective communication, 4th Edition, Pan MacMillan, 2009.
12. Daniels A.C, Bringing out the best in people, 2nd Edition, Mc Graw Hill Education, New York, 1999.

BP112RBP Remedial Biology (Practical)

Course Objectives:

To give the learner preliminary knowledge of biology.

Course Outcomes

The learners should be able to:

1. Have knowledge of microscopes and microscopic study of tissues.
2. Identify plant parts and modification.
3. Explain some body processes.

BP112RBP Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	3	-	2	1	-	1	2	2
CO2	3	2	2	2	-	-	1	-	1	2	2
CO3	3	2	2	-	2	2	2	1	2	1	2

While mapping Course Outcomes (CO) with POs the degree of association is indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details
1	Introduction to experiments in biology a) Study of Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation
2	Study of cell and its inclusions
3	Study of stem, root, leaf, seed, fruit, flower and their modifications
4	Detailed study of frog by using computer models
5	Microscopic study and identification of tissues pertinent to stem, root, leaf, seed, fruit and flower
6	Identification of bones
7	Determination of blood group
8	Determination of blood pressure
9	Determination of tidal volume

Reference Books (Latest Edition to be adopted):

1. Kale. S.R. and Kale R.R, Practical Human Anatomy and Physiology, 10th edition, Nirali Prakashan, Pune, 2020.
2. Gokhale S.B., Kokate C.K. and Shrivastava, S.P. A Manual of Pharmaceutical biology practical.
3. Shafi M, Biology practical manual according to National core curriculum. Biology forum of Karnataka.

SEMESTER
IIBP201T

Human Anatomy and Physiology-II (Theory)

45 Hours

Course Objectives:

To give the learner in-depth information on the organ systems and homeostatic mechanisms.

Course Outcomes:

The learners should be able to:

1. Elucidate the gross morphology, structure, and function of various organs of the human body.
2. Understand the coordinated working pattern among different organs within each system of the human body.
3. Correlate the mechanisms in the maintenance of homeostasis of human body by cross functioning of the various systems.

Mapping CO-PO:

BP201T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	-	3	-	2	3	-	3
CO2	3	2	2	2	-	3	-	2	3	-	3

CO3	3	2	2	2	-	3	-	2	3	-	3
-----	---	---	---	---	---	---	---	---	---	---	---

While mapping Course Outcomes (CO) with POs the degree of associations is indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
1	Nervous system • Organization of nervous system • Neuron, neuroglia, classification, and properties of nerve fibre, • Electrophysiology, action potential, nerve impulse	10
	• Receptors, synapse, and neurotransmitters • Central nervous system: meninges, ventricles of brain and cerebrospinal fluid • Structure and functions of brain (cerebrum, brainstem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)	
2	Digestive system • Anatomy and physiology of the gastrointestinal tract and associated organs • Functions of stomach • Digestion and absorption of carbohydrates, proteins, and fats	5
3	Respiratory System • Anatomy and physiology of respiratory system • Exchange of gases • External and internal respiration • Mechanism and regulation of respiration • Lung volumes and lung capacities • Artificial respiration and resuscitation methods	5
4	Urinary system • Anatomy of urinary tract with special reference to anatomy of kidney and nephrons • Functions of kidney and urinary tract, • Physiology of urine formation, micturition reflex • Role of kidney in acid base balance • Role of renin-angiotensin system	7
5	Endocrine system • Classification of hormones • Mechanism of hormone action • Structure and functions of endocrine tissues and glands • Disorders associated with endocrine system	8
6	Reproductive system • Anatomy of male and female reproductive system • Functions of male and female reproductive system • Sex hormones • Physiology of menstruation • Fertilization, spermatogenesis, oogenesis, pregnancy, and parturition • Introduction to genetics: chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	10

	TOTAL	45
--	--------------	-----------

Reference Books (Latest Edition to be adopted):

1. Waugh A., and Grant A., Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
2. Tortora G.J. & Derrickson B., Principles of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey, 2016
3. Guyton A.C., Hall J.E., Textbook of Medical Physiology, 12th edition, W.B. Saunders Company, USA/Prism Books Ltd. India, 2010.
4. Mackenna B. R. & Callander R., McNaught & Callander's Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
6. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
7. Mohan H., Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
8. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017.

BP202T

PHARMACEUTICAL ORGANIC CHEMISTRY-I (Theory)

45 Hours

Course Objectives: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions, and methods of preparation of these compounds. The syllabus also emphasizes mechanisms and orientation of reactions.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. **Explain** the reaction, mechanism and reactivity and orientation of elimination reaction, nucleophilic substitution and addition reactions.
2. **Classify** various classes of organic compounds & infer the rules of IUPAC and common system of nomenclature for various classes of organic compounds with examples.
3. **Predict** the effect of various substituents on acidity and basicity of carboxylic acids and amines respectively.
4. **Recall** the structure and medicinal uses of the organic compounds.
5. **Apply** the mechanisms of organic reactions and common naming reactions in the synthesis of drug molecules.
6. **Illustrate** the stereo-chemical features including conformation and stereo electronic effects of organic molecules.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP202T CO1	2	1	1	-	-	1	-	-	1	1	1
BP202T CO2	2	-	2	2	-	-	-	-	-	-	2
BP202T CO3	2	1	3	-	-	1	-	-	-	-	1
BP202T CO4	3	-	1	-	-	2	2	2	2	1	2

Syllabus B.Pharm (PCI)



BP202T CO5	2	2	2	1	1	1	1	2	1	1	1
BP202T CO6	2	2	2	1	1	1	-	1	-	-	1

While mapping Course Outcomes (CO) with POs the degree of association is indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
	Course Content: General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.	
1	Classification, nomenclature, and isomerism Classification of organic compounds, common and IUPAC systems of nomenclature of organic compounds (upto 10 Carbons open chain and carbocyclic compounds) Structural isomerism in organic compounds.	6
2	Alkanes*, Alkenes* and Conjugated dienes* SP ³ hybridization in alkanes, halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP ² hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeff's orientation and evidence. E1 versus E2 reactions, Factors affecting E1 and E2 reactions. ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.	10
3	Alkyl halides* SN1 and SN2 reactions – kinetics, order of reactivity of alkyl halides, stereochemistry, and rearrangement of carbocations. SN1 versus SN2 reactions, factors affecting SN1 and SN2 reactions. Structure and uses of ethyl chloride, chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. Alcohols* – Qualitative tests, Structure and uses of ethyl alcohol, methyl alcohol, chlorobutanol, cetosteryl alcohol, benzyl alcohol, glycerol, propylene glycol.	10
4	Carbonyl compounds* (Aldehydes and ketones) Nucleophilic addition, electromeric effect, aldol condensation, crossed aldol condensation, Cannizzaro reaction, crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, structure and uses of formaldehyde, paraldehyde, acetone, chloral hydrate, hexamine, benzaldehyde, vanillin, cinnamaldehyde.	9

5	Carboxylicacids* Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide, and ester. Structure and uses of acetic acid, lactic acid, tartaric acid, citric acid, succinic acid, oxalic acid, salicylic acid, benzoic acid, benzyl benzoate, dimethyl phthalate, methyl salicylate and acetylsalicylic acid. Aliphatic amines* basicity, effect of substituent on basicity, qualitative test, structure and uses of ethanolamine, ethylenediamine, amphetamine.	10
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992
2. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Longman, 1963
3. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
4. Soni P. L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
5. Mann F. G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York, and Toronto, 1960
6. Vogel A. I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989
7. Vishnoi N. K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979
8. Engel R. G., Pavia D. L., Lampman G. N., Kriz G. S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010.
9. Ahluwalia V. K., Parashar R. K., Organic Reaction Mechanisms, 4th edition, Narosa Publishing House, 2010

BP203T

BIOCHEMISTRY (Theory)

45 Hours

Course Objectives:

Biochemistry deals with complete understanding of the molecular level of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Course Outcomes:

Upon completion of course students shall be able to:

1. **Explain** the concept of bioenergetics, energy rich compounds, and to **apply** the principle in electron transport chain and oxidative phosphorylation.
2. **Demonstrate** the catalytic role of enzymes, their application in therapeutic and diagnostic level and to **assess** the significance of enzyme inhibitors in the design of new drugs.
3. **Understand** lipid and amino acid metabolic pathways and study various diseases and disorders linked to them.
4. **Outline** the purine and pyrimidine nucleotide biosynthesis and degradation pathways and various drugs targeting these pathways.
5. **Learn and understand** the structures of DNA, RNA, Proteins and basic cellular processes like DNA replication, transcription and translation.
6. **Elaborate** the principle involved in the metabolism of carbohydrates, proteins and lipids and to interpret their effect on physiological and pathological conditions.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP203T CO1	2	2	2	-	-	1	1	1	-	-	1
BP203T CO2	2	1	2	-	1	2	2	2	1	-	2
BP203T CO3	2	-	2	-	-	1	1	1	1	-	1
BP203T CO4	2	2	2	-	-	1	-	-	1	-	1
BP203T CO5	2	-	1	-	1	-	1	1	1	-	2
BP203T CO6	3	-	2	-	-	2	-	2	2	-	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	Biomolecules Introduction, classification, chemical nature, and biological role of carbohydrate, lipids, nucleic acids, amino acids, and proteins. Bioenergetics Concept of free energy, endergonic and exergonic reaction, relationship between free energy, enthalpy, and entropy; Redox potential, energy rich compounds; classification; biological significances of ATP and cyclic AMP.	8
2	Carbohydrate metabolism Glycolysis – pathway, energetics, and significance. Citric acid cycle – pathway, energetics, and significance. HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency. Glycogen metabolism pathways and glycogen storage diseases (GSD) Gluconeogenesis – pathway and its significance. Hormonal regulation of blood glucose level and diabetes mellitus. Biological oxidation Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate. Phosphorylation Inhibitors ETC and oxidative phosphorylation/uncouplers Level.	10
3	Lipid metabolism β -Oxidation of saturated fatty acid (Palmitic acid). Formation and utilization of ketone bodies; ketoacidosis. De novo synthesis of fatty acids (Palmitic acid). Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.	10



	Amino acid metabolism General reactions of amino acid metabolism: transamination, deamination & decarboxylation, urea cycle and its disorders. Catabolism of phenylalanine and tyrosine and their metabolic disorders (phenylketonuria, albinism, alcaptonuria, tyrosinemia). Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice.	
4	Nucleic acid metabolism and genetic information transfer Biosynthesis of purine and pyrimidine nucleotides. Catabolism of purine nucleotides and hyperuricemia and gout disease. Organization of mammalian genome. Structure of DNA and RNA and their functions. DNA replication (semiconservative model). Transcription and RNA synthesis. Genetic code, Translation and Protein synthesis and inhibitors.	10
5	Enzymes Introduction, properties, nomenclature and IUB classification of enzymes. Enzyme kinetics (Michaelis plot, Lineweaver Burk plot, Eadie Hofstee plot), enzyme inhibitors with examples. Regulation of enzymes: enzyme induction and repression, allosteric enzyme regulation. Therapeutic and diagnostic applications of enzymes and isoenzymes. Coenzymes – structure and biochemical functions.	7
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Lehninger AL, Nelson DL, Cox MM. Lehninger Principles of Biochemistry, 7th edition, Macmillan, New York, 2017.
2. Murray RK, Granner DK, Mayes PA, Rodwell VW, Harper's Biochemistry, 23rd edition, Appleton & Lange, Connecticut, 1993.
3. Berg JM, Tymoczko JL, Stryer L. Biochemistry, 9th edition, W H Freeman, New York, 2019.
4. Satyanarayan, U and Chakrapani, U. Biochemistry, 4th edition, Elsevier, New Delhi, 2013.
5. Rao AR. Textbook of Biochemistry, 11th edition, UBS Publishers and Distributors, 2009.
6. Deb AC, Fundamentals of Biochemistry, 7th edition, New Central Book Agency, Kolkata, 2001.
7. Conn E, Stumpf P, Outlines of Biochemistry, 5th edition, John Wiley & Sons, New York, 1987.
8. Gupta RC and Bhargava S, Practical Biochemistry, 5th edition, CBS Publishers and Distributors (P), Ltd, New Delhi.
9. Plummer DT, Introduction of Practical Biochemistry (3rd Edition), Tata McGraw-Hill Education Pvt. Ltd., 2004.
10. Rajagopal, G. Ramakrishnan, Practical Biochemistry for Medical students, 1st edition, K. K. Publications, New Delhi, 1983.
11. Varley H, Gowenlock A H, McMurray JR; McLauchlan DM, Practical Biochemistry, 6th edition, CBS Publishers and Distributors, New Delhi, 2006.

BP204T

Pathophysiology (Theory)

45 Hours

Course Objectives:

To impart to the learner the knowledge of pathophysiology and apply it to development of pharmacotherapeutics.

Course Outcomes

The learners should be able to:

1. Describe the etiology and pathogenesis of these selected disease states.
2. Explain the signs and symptoms of the diseases.
3. Deduce the complications of pathology on health.

Mapping CO-PO:

BP204T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	-	3	3	2	3	-	3
CO2	3	2	3	3	-	3	3	2	3	-	3
CO3	3	2	3	3	-	3	3	2	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
1	Cell injury and Adaptation: • Basic principles of Introduction, definitions • Homeostasis: components and types of feedback systems • Causes of cellular injury. • Mechanisms of cell injury: cell membrane damage, mitochondrial damage, ribosome damage, nuclear damage. • Morphology of cell injury: adaptive changes (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia), cell swelling, intracellular accumulation, calcification, enzyme leakage. • Cell Death and apoptosis. • Acidosis & Alkalosis. • Electrolyte imbalance.	6
2	Inflammation and repair • Basic mechanism involved in the process of inflammation and repair: • Clinical signs of inflammation. • Different types of Inflammation. • Mechanism of Inflammation – alteration in vascular permeability and blood flow, migration of WBC's. • Mediators of inflammation. • Basic principles of wound healing in the skin.	4
3	Cancer • Classification. • Etiology and pathogenesis of cancer.	2
4	Cardiovascular System • Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis).	6
5	Respiratory system • Asthma, chronic obstructive airways diseases.	2
6	Renal system • Acute and chronic renal failure.	2

Syllabus B.Pharm (PCI)



7	Haematological Diseases Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia.	4
8	Endocrine system Diabetes, thyroid diseases, disorders of sex hormones.	4
9	Nervous system Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.	6
10	Gastrointestinal system Peptic ulcer, inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.	3
11	Disease of bones and joints Rheumatoid arthritis, osteoporosis, and gout.	2
12	Infectious diseases Meningitis, typhoid, leprosy, tuberculosis, urinary tract infections.	2
13	Sexually transmitted diseases AIDS, syphilis, gonorrhoea.	2
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Kumar Vinay, Abbas A.K., Aster, J.C. Robbins & Cotran Pathologic Basis of Disease; 10th edition, South Asia edition; Elsevier, India, 2014.
- Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
- Brunton, L.L., Hilal-Dandan R, Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
- Best C.H., Taylor N.B., West J.B, Best and Taylor's Physiological Basis of Medical Practice; 12th edition, Williams and Wilkins, Baltimore, USA, 1991.
- Walker, B., College, N.R., Ralston S., Penman, I., Davidson's Principles and Practice of Medicine; 22nd edition, Churchill Livingstone, New York, 2014.
- Guyton A.C., Hall J.E., Textbook of Medical Physiology, 12th edition, Saunders, USA/Prism Books Ltd. India, 2010.
- Di Piro J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G., Posey, L.M., Pharmacotherapy: A Pathophysiological Approach; 9th edition, McGraw-Hill Medical, London, 2014.
- Kumar V., Cotran R.S, Robbins S. L, Basic Pathology; 7th edition; WB Saunders Company, Philadelphia/Harcourt (India) Pvt. Ltd., New Delhi, 2003.
- Walker R, Edwards, Clinical Pharmacy and Therapeutics, 3rd edition; Churchill Livingstone Edinburgh, New York, 2003.

Recommended Journals:

- The Journal of Pathology. ISSN: 1096-9896 (Online)
- The American Journal of Pathology. ISSN: 0002-9440
- Pathology. 1465-3931 (Online)
- International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
- Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

Course Objectives:

This subject deals with the introduction of databases, database management systems, computer application in clinical studies and use of databases.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Know the various types of application of computers in pharmacy
2. Know the various types of databases
3. Know the various applications of databases in pharmacy

BP205T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	3	1	2	1	2	1	2	2
CO2	3	2	2	3	-	1	1	2	1	1	2
CO3	3	2	2	3	1	2	1	2	1	2	2

While mapping Course Outcomes (CO) with POs the degree of association is indicated as 3 (Strong), 2 (Moderate), 1 (Weak), - (No relation)

Unit	Details	Hours
1	Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division. Concept of Information Systems and Software: Information gathering, requirement analysis and feasibility analysis, data flow diagrams, process specifications, input/output design, process lifecycle, planning and managing the project.	6
2	Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MySQL, MS ACCESS, Pharmacy Drug database.	6
3	Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System.	6
4	Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.	6
5	Computers as data analysis in Preclinical development: Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS).	6
	TOTAL	30

Reference Books (Latest Edition to be adopted):

1. Fassett, W.E., Computer Application in Pharmacy, 1st edition, Lea and Febiger, Philadelphia, USA, 1986.
2. Sean E, Binghe W., Computer Application in Pharmaceutical Research and Development, 1st edition, John Wiley and Sons, Inc., New Jersey, USA, 2006.
3. Rastogi, S.C., Mendiratta, N, Rastogi, P., Bioinformatics (Concept, Skills and Applications), 2nd edition, CBS Publishers and Distributors, New Delhi, 2008.
4. Prague, C.N., Irwin, M.R., Reardon, J., Microsoft Office Access- 2003, Application Development Using VBA, SQL Server, DAP and InfoPath, Wiley India Pvt. Ltd, New Delhi.

BP206T
ENVIRONMENTAL SCIENCES (Theory) **30 hours**

Course Objectives:

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Course Outcomes:

Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with nature.

BP206T	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
<i>Course Outcomes</i>											
CO1	3	3	3	2	1	2	1	3	2	3	3
CO2	3	3	2	1	1	2	1	2	1	3	3
CO3	3	3	3	1	1	2	1	2	2	3	3
CO4	3	3	3	1	2	2	1	3	1	3	3
CO5	3	3	3	3	2	2	1	3	2	3	3
CO6	3	3	2	1	1	1	1	2	1	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details	Hours
------	---------	-------

Syllabus B.Pharm (PCI)



1	The Multidisciplinary nature of environmental studies. Natural Resources. Renewable and non-renewable resources: Natural resources and associated problems. a) forest resources; b) water resources; c) mineral resources; d) food resources; e) energy resources; f) land resources: role of an individual in conservation of natural resources.	10
2	Ecosystems. - Concept of an ecosystem. - Structure and function of an ecosystem. - Introduction, types, characteristic features, structure, and function of the ecosystems: forest ecosystem; grassland ecosystem; desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	10
3	Environmental Pollution: air pollution; water pollution; soil pollution.	10
	TOTAL	30

Reference Books (Latest Edition to be adopted):

1. Singh Y.K., Environmental Science, 1st edition, New Age International Pvt, Publishers, Bangalore, 2006.
2. Agarwal, K.C., Environmental Biology, 2nd edition, Nidhi Publishers, Bikaner, 2008.
3. Bharucha E., The Biodiversity of India, 1st edition, Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2002.
4. Brunner C.R., Hazardous Waste Incineration, McGraw Hill Inc, USA, 1989
5. Clark R.S., Marine Pollution, Clarendon Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorham, E. & Hepworth, M.T., Environmental Encyclopedia, 2nd edition, Cengage Gale, USA, 2001.
7. De A.K., De A.K., Environmental Chemistry, New Age International Publishers Ltd, New Delhi, 1990.
8. Narain S., Down to Earth - fortnightly magazine focused on politics of environment and development of Centre for Science and Environment, New Delhi, India,
- 9.

BP207P

Human anatomy and Physiology II (Practical)

Course Objectives:

To get the learner adept with anatomy, physiology and pathology of body systems.

Course Outcomes

The learners should be able to:

1. Be proficient with the working of the systems of the body including the process of homeostasis.
2. Identify and describe the various body tissues and the pathological changes in diseased states.

Mapping CO-PO:

BP207P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	2	2	3	3	2	3	-	3
CO2	3	3	3	2	2	3	3	2	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details
------	---------

1	Study of the systems with the help of models, charts, and specimens: • Nervous system • Endocrine system • Digestive • Respiratory • Cardiovascular • Urinary • Reproductive
2	To demonstrate the general neurological examination.
3	To study the integumentary and special senses using specimen, models, etc.: • Touch • Olfaction • Taste • Vision and visual acuity
4	To demonstrate the reflex activity.
5	Recording of body temperature.
6	To demonstrate positive and negative feedback mechanism.
7	Determination of tidal volume and vital capacity.
8	Recording of basal mass index.
10	Study of family planning devices and pregnancy diagnosis test.
11	Demonstration of total blood count by cell analyser
12	Permanent slides of vital organs and gonads: • Ovary, Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein
13	Discussion on some common investigational procedures used in diagnostics: 1) Electroencephalogram (EEG) 2) Positron emission tomography (PET) 3) Computed tomography scan (CT Scan) 4) Flow cytometry as a diagnostic tool 5) Polymerase chain reaction as a diagnostic tool 6) Electrocardiogram (ECG) in diagnosis of cardiac arrhythmia 7) Liver Function tests 8) Kidney Function tests 9) Blood Glucose 10) Serum Cholesterol/Triglycerides 11) Serum Calcium 12) Thyroid Function tests
	13) Diagnostic tests for infectious diseases like- Malaria, Tuberculosis, Dengue, H1N1 swine flu, Typhoid and Covid 19.

Reference Books (Latest Edition to be adopted):

1. Mackenna B.R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
2. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition
3. Lippincott, Williams and Wilkins, USA, 1995.

4. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
5. Ghai C.L., Textbook of Practical Physiology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2005.
6. Mohan H., Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
7. Waugh A., and Grant A., Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
8. Tortora G.J. & Derrickson B., Principles of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey, 2016
9. Guyton A.C., Hall J.E., Textbook of Medical Physiology, 12th edition, W.B. Saunders Company, USA/Prism Books Ltd. India, 2010.

BP208P

PHARMACEUTICAL ORGANIC CHEMISTRY-I (Practical)

Course Objectives:

To get the learner introduced to the basic principles of qualitative organic analysis

Course Outcomes

1. Identify the various classes of organic compounds by performing systematic qualitative analysis.
2. Construct the molecular models of simple organic compounds.
3. Outline the synthesis and purification of various classes of organic compounds with one step reaction.
4. Demonstrate and perform the melting and boiling points of organic compounds.
5. Remember/Understand the basic etiquettes of laboratory glassware, fire safety hazards and personal protection measures and follow good laboratory practices (GLP)

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP208P CO1	3	2	3	-	1	1	1	2	-	-	1
BP208P CO2	3	3	2	2	1	-	-	-	-	-	1
BP208P CO3	2	2	3	1	1	1	2	1	1	1	1
BP208P CO4	2	2	2	-	1	2	2	-	1	-	1
BP208P CO5	2	2	2	-	2	2	2	1	1	1	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details
1	Systematic qualitative analysis of unknown organic compounds like 1. Preliminary test: color, odour, aliphatic/aromatic compounds, saturation, and unsaturation, etc. 2. Detection of elements like nitrogen, sulphur, and halogen by Lassaigne's test. 3. Solubility test. 4. Functional group test like phenols, amides/urea, carbohydrates, amines, carboxylic acids, aldehydes and ketones, alcohols, esters, aromatic and halogenated Hydrocarbons, nitro compounds and anilides.



	5. Meltingpoint/boilingpointoforganiccompounds. 6. Identificationoftheunknowncompoundfromtheliteratureusingmeltingpoint/boilingpoint. 7. Preparationofthederivativesandconfirmationoftheunknowncompoundbymeltingpoint/boilingpoint. 8. Minimumfiveunknownorganiccompoundstobeanalyzedsystematically.
2	Preparationofsuitable solidderivativesfromorganiccompounds.
3	Constructionofmolecularmodels.

Reference Books (Latest Edition to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992
2. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963
3. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
4. Soni P. L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
5. Mann F. G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York and Toronto, 1960
6. Vogel A. I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989
7. Vishnoi N. K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979
8. Engel R. G., Pavia D. L., Lampman G. N., Kriz G. S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010
9. Ahluwalia V. K., Parashar R. K., Organic Reaction Mechanisms, 4th edition, Narosa Publishing House, 2010

BP209P BIOCHEMISTRY (Practical)

Course Objectives:

To get the learner introduced to the basic principles of qualitative and quantitative determination of important biomolecules.

Course Outcomes

The learners should be able to:

1. **Explain** the preparation of buffers and measurement of pH and their significance in pharmacy.
2. **Identify** various classes of carbohydrates and proteins by performing the systematic qualitative analysis.
3. **Estimate** and **interpret** serum creatinine, blood glucose, cholesterol and urine (for abnormal constituents) and their disease correlation.
4. **Understand** the principle and factors affecting enzyme activity
5. **Remember/Understand** the basic etiquettes of laboratory glassware, fire safety hazards and personal protection measures and follow good laboratory practices (GLP)

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP209P CO1	2	2	2	1	1	2	1	1	1	-	2
BP209P CO2	3	3	2	-	1	-	-	1	2	-	2
BP209P CO3	3	2	3	2	1	2	2	2	2	-	2
BP209P CO4	2	1	2	2	-	1	1	2	1	-	2
BP209P CO5	2	2	2	-	2	2	2	1	1	1	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details
1	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2	Identification tests for Proteins (albumin and Casein)
3	Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4	Qualitative analysis of urine for abnormal constituents
5	Determination of blood creatinine
6	Determination of blood sugar
7	Determination of serum total cholesterol
8	Preparation of buffer solution and measurement of pH
9	Study of enzymatic hydrolysis of starch
10	Determination of Salivary amylase activity
11	Study of the effect of Temperature on Salivary amylase activity
12	Study of the effect of substrate concentration on salivary amylase activity

Reference Books (Latest Edition to be adopted):

1. Lehninger AL, Nelson DL, Cox MM. Lehninger Principles of Biochemistry, 7th edition, Macmillan, New York, 2017.
2. Murry RK, Granner DK, Mayes PA, Rodwell VW, Harper's Biochemistry, 23rd edition, Appleton & Lange, Connecticut, 1993.
3. Berg JM, Tymoczko JL, Stryer L. Biochemistry, 9th edition, WH Freeman, New York, 2019.
4. Satyanarayan, U and Chakrapani, U. Biochemistry, 4th edition, Elsevier, New Delhi, 2013.
5. Rao AR. Textbook of Biochemistry, 11th edition, UBSPublishers and Distributors, 2009.
6. Deb AC, Fundamentals of Biochemistry, 7th edition, New Central Book Agency, Kolkatta, 2001
7. Conn E, Stumpf P, Outlines of Biochemistry, 5th edition, John Wiley & Sons, New York, 1987
8. Gupta RC and Bhargava S, Practical Biochemistry, 5th edition, CBS Publishers and Distributors (P), Ltd, New Delhi.
9. Plummer DT, Introduction of Practical Biochemistry (3rd Edition), Tata McGraw-Hill Education Pvt. Ltd., 2004
10. Rajagopal, G. Ramakrishnan, Practical Biochemistry for Medical students, 1st edition, K.K. Publications, New Delhi, 1983.
11. Varley H, Gowenlock AH, McMurray JR; McLauchlan DM, Practical Biochemistry, 6th edition, CBS Publishers and Distributors, New Delhi, 2006.

BP210P

COMPUTER APPLICATIONS IN PHARMACY (Practical)

Course Objectives:

To equip students with hands-on experience in using computer tools for designing questionnaires, creating web pages, managing databases, and retrieving drug information, focusing on word processing, HTML, MS Access, and other relevant pharmacy-related applications.

Course Outcomes:

Upon completion of the course, the learner shall be able to:

1. Design forms, web pages, and questionnaires using various computer applications for gathering and presenting pharmacy-related information.

2. Develop, manage, and query databases for storing, modifying, and retrieving patient and drug information using MS Access.
3. Apply computer tools to retrieve drug information, generate reports, and create mailing labels, contributing to efficient pharmacy management practices.

BP210P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	3	2	2	1	3	1	2	2
CO2	3	2	2	3	1	2	1	2	1	2	2
CO3	3	2	2	3	1	2	1	3	1	2	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

Unit	Details
1	Design a questionnaire using a word processing package to gather information about a disease
2	Create a HTML web page to show personal information
3	Retrieve the information of a drug and its adverse effects using online tools
4	Creating mailing labels Using Label Wizard, generating label in MSWORD
5	Creating mailing labels Using Label Wizard, generating label in MSWORD
6	Create a database in MS Access to store the patient information with the required fields Using MS Access
7	Design a form in MS Access to view, add, delete, and modify the patient record in the database
8	Generating report and printing the report from patient database
9	Creating invoice table using – MS Access
10	Drug information storage and retrieval using MS Access
11	Creating and working with queries in MS Access
12	Exporting Tables, Queries, Forms and Reports to web pages
13	Exporting Tables, Queries, Forms and Reports to XML pages

Reference Books (Latest Edition to be adopted):

1. Fassett, W.E., Computer Application in Pharmacy, 1st edition, Lea and Febiger, Philadelphia, USA, 1986.
2. Sean, E., Binghe W., Computer Application in Pharmaceutical Research and Development, 1st edition, John Wiley and Sons, Inc., New Jersey, USA, 2006.
3. Rastogi, S.C., Mendiratta, N., Rastogi, P., Bioinformatics (Concept, Skills and Applications), 2nd edition, CBS Publishers and Distributors, New Delhi, 2008.
4. Prague, C.N., Irwin, M.R., Reardon, J., Microsoft Office Access - 2003, Application Development Using VBA, SQL Server, DAP and InfoPath, Wiley India Pvt. Ltd, New Delhi

SEMESTER

III BP301T

PHARMACEUTICAL ORGANIC CHEMISTRY–II (Theory)

45 Hours

Course Objectives: To introduce the learner to the general methods of preparation and reactions of some organic compounds, reactivity of organic compounds, mechanisms, orientation of reactions.

Course Outcomes:

Upon completion of the course the student shall be able to:

1. **Interpret and Solve** the nomenclature of aromatic compounds by analyzing chemical structure.
2. **Outline** the synthesis of aromatic compounds by different methods; and to predict reactivity/ stability of organic compounds.
3. **Explain** the mechanism and orientation of important reactions of aromatic compounds
4. **Understand** various theories to explain stability of cycloalkanes.
5. **Compare** angle strain / torsional strain of cycloalkanes and interpret their stability patterns.
6. **Explain** the chemistry of fats and oils; and to determine the analytical constants of fats and oils with their significance.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP301T CO1	1	1	2	2	-	-	1	-	-	-	1
BP301T CO2	2	2	2	1	-	1	1	1	1	-	1
BP301T CO3	1	1	3	-	-	1	1	1	-	-	1
BP301T CO4	2	-	3	-	-	1	-	-	-	-	2
BP301T CO5	2	-	3	-	-	1	-	-	-	-	2
BP301T CO6	2	2	2	1	-	1	1	2	2	1	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
	<i>General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.</i>	
1	Benzene and its derivatives	10
1.1	Analytical, synthetic, and other evidence in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule.	3
1.2	Reactions of benzene-nitration, sulphonation, halogenation-reactivity, Friedel-Crafts alkylation-reactivity, limitations, Friedel-Crafts acylation.	3
1.3	Substituents, effect of substituents on reactivity and orientation of monosubstituted benzene compound towards electrophilic substitution reaction.	3
1.4	Structure and uses of DDT, Saccharin, BHC and Chloramine.	1
2		10



2.1	Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols.	5
2.2	Aromatic Amines* -Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts.	3
2.3	Aromatic Acids* –Acidity, effect of substituents on acidity and important reactions of benzoic acid.	2
3	Fats and Oils	10
3.1	Fatty acids –reactions.	4
3.2	Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.	3
3.3	Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (R.M.) value –significance and principle involved in their determination.	3
4	Polynuclear hydrocarbons:	08
4.1	Synthesis, reactions.	4
4.2	Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives.	4
5	Cycloalkanes	07
	Stabilities –Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse-Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.	
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992.
- Pine, Stanley H.; Hendrickson, James B.; Cram, Donald J.; Hammond, George S., Organic Chemistry, 4th edition, McGraw Hill Publications, USA, 1982.
- Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963.
- March J., Smith M. B., Advanced Organic Chemistry: Reactions, Mechanisms, Structures, 6th edition, John Wiley and Sons publication, USA, 2007.
- Carey F. A., Sundberg R. J., Organic Chemistry, Part A: Structures and Mechanism, Part B: Reactions and Synthesis, 4th edition Kluwer Academic Publishers, USA, 2002.
- Sykes P., A Guidebook to Mechanism in Organic Chemistry, 6th edition, Pearson Education, India, 1960.
- Dewick P., Essentials of Organic Chemistry, 1st edition, John Wiley and Sons, New Jersey, 2006.
- Wade L. G. Jr., Maya Shankar Singh, Advanced Organic Chemistry: Reactions and Mechanism, 9th edition, Pearson Education, India, 2019.
- Elie E. L., Wilen S. H., Stereochemistry of Organic Compounds, 1st edition, John Wiley and Sons, USA, 1994.
- Sorrell T. N., Organic Chemistry, 2nd edition, University Science Books, USA, 2005.
- Kalsi P. S., Stereochemistry: Conformation and Mechanism, Organic Reactions and Their Mechanisms, New Age International Publishers, New Delhi, 2017.
- Brahmachari G., Organic Chemistry through Solved Problems, revised edition, Alpha Science International Ltd., Morgan & Claypool Publishers, 2007.
- Brahmachari G., Organic Name Reactions: A Unified Approach, Alpha Science International Ltd., Morgan, and Claypool Publications, 2006.

BP302T
PHYSICAL PHARMACEUTICS-I (Theory)

45 Hours

Course Objectives:

The objective of the course is to train the learner for understanding the basic physical principles underlying pre-formulation testing, formulation development and finished product testing of drug delivery systems.

Course Outcomes:

Upon completion of this course the student should be able to:

1. Describe, compare, and correlate the states of matter with their corresponding physicochemical properties of drug molecules.
2. Comprehend the various theories of surface and interfacial phenomenon.
3. Apply knowledge of solubilization techniques, surface and interfacial phenomenon concepts in designing dosage form of drugs.
4. Comprehend and evaluate the influence of pH, diffusion and dissolution kinetics on drug in various dosage forms.
5. Understanding of the laws of thermodynamics and applications of thermochemistry.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP302T CO1	3	1	3	2	-	2	2	2	1	2	3
BP302T CO2	3	1	3	2	-	2	2	2	1	2	3
BP302T CO3	3	1	3	2	-	2	2	2	1	2	3
BP302T CO4	3	1	3	2	-	2	2	2	1	2	3
BP302T CO5	3	1	3	2	-	2	2	2	1	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
	States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols-inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism.	6
	Physicochemical properties of drug molecules: Additive, constitutive, and colligative properties with examples; Concept of tonicity in pharmacy, methods to adjust isotonicity; Refractive index and molar refraction, optical rotation, dielectric constant, dipole moment, determinations, and applications	4
2	UNIT-II	8
	Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface. Adsorption isotherms, Freundlich adsorption isotherm, Langmuir adsorption isotherm Wetting, wetting agents and contact angle	
3	UNIT-III	14

	Solubility of drugs: Solubility expressions, mechanisms of solute-solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	7
	Diffusion and Dissolution: Diffusion; diffusion through biological membranes, Fick's Laws of diffusion, Steady state diffusion, driving forces for diffusion in pharmaceutical systems, permeability. Measurement of diffusion; Concept of dissolution, dissolution mechanism; Noyes-Whitney equation, factors affecting dissolution; Intrinsic Dissolution Rate, Hixson-Crowell Law, measurement of dissolution rates	7
4	UNIT-IV pH, buffers and Isotonic solutions: Theory of dissociation, dissociation constant, Sorensen's pH scale, pH determination, (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	6
5	UNIT-V Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants	7
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BIWaverly Pvt Ltd, New Delhi, 1993.
- Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
- Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
- Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
- Stocklosa M.J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
- Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol. 1, 2, 3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
- Lieberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
- Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, Pharma Med Press, 2017
- C.V.S. Subramanyam, J. Thimmasettee, Laboratory Manual of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2014.
- C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015

11. C.V.S.Subrahmanyam,EssentialsofPhysicalPharmaceutics,2nd edition,VallabhPrakashan,Delhi,2017
12. JainG,KharRK,AhmadFJ,TheoryandPracticeofPhysicalPharmacy,1st Edition,ElsevierIndia,2013
13. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications,NewDelhi,2000.

BP303T

PHARMACEUTICAL MICROBIOLOGY(Theory)

45Hours

Course Objectives:

Study morphology, classification, and reproduction of all categories of microorganisms especially which cause diseases, microbiological tests, aseptic handling, and sterilization aspects.

Course Outcomes:

Upon completion of the subject student shall be able to:

1. Know the general microbiological aspects, describe techniques of identification, cultivation, and preservation of various bacteria.
2. Highlight the disease-causing microorganisms and their pathogenesis.
3. Recognize the source of contamination as well as spoilage and the role of disinfectants, antiseptics and sterility testing in pharmaceutical processing and industry.
4. Compare the different methods of sterilization & equipment and know the general design of aseptic area.
5. Comprehend techniques of preservation of pharmaceuticals and basic knowledge of cell culture technology.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP303T CO1	3	1	1	1	1	3	3	1	3	3	3
BP303T CO2	3	1	1	1	1	3	3	1	3	3	3
BP303T CO3	3	1	3	1	1	3	3	1	3	3	3
BP303T CO4	3	1	2	1	1	3	3	1	3	3	3
BP303T CO5	3	1	2	3	1	3	3	1	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	Introduction, history of microbiology, its branches, scope, and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of the different types of simple & compound microscope, phase contrast microscopy, dark field microscopy and electron microscopy.	08

Syllabus B.Pharm (PCI)



2	Study of morphology, classification, reproduction/replication and cultivation of Bacteria, Fungi, Viruses and Rickettsiae and Chlamydiae. Overview of bacterial diseases and pathogens causing them. Mycobacteria, shigella, pseudomonas, klebsiella, streptococcus, staphylococcus, clostridium vibrio. Viral diseases including new emerging viral diseases-COVID, ZICA, SARS, EBOLA. Fungal diseases. Protozoal diseases- Amoeba, Paramecium, Trichomonas, Plasmodium. Rickettsial & Chlamydial diseases. Protozoa- Morphological characteristics and classification, reproduction, pathogenic protozoa like Amoeba, Paramecium, Trichomonas, Plasmodium. Algae - Classification, Morphological characteristics, reproduction, economic significance of algae. Pattern of microbial death.	13
3	Identification of bacteria using staining techniques (simple, Gram's & Acid-fast staining) and biochemical tests (IMViC). Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins, and amino acids. Assessment of a new antibiotic.	06
4	Classification and mode of action of disinfectants. Factors influencing disinfection, antiseptics, and their evaluation. For bacteriostatic and bactericidal actions, Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. Study of principle, procedure, merits, demerits and applications of physical, chemical, gaseous radiation and mechanical methods of sterilization. Evaluation of the efficiency of sterilization methods. Equipment employed in large scale sterilization. Sterility indicators. Designing of aseptic area, laminar flow equipment; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.	10
5	Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources, and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research. Disposal of Microbial waste	08
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Hugo W.B. and Russel
A.D, Pharmaceutical Microbiology, 8th Edition, Blackwell Scientific publications, Oxford, London, 2013.
- Reed G., Prescott, and Dunn's., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2004.
- Pelczar MJ, Chan ECS, Kreig NR. Microbiology, 6th Edition, Tata McGraw Hill Education Pvt. Ltd, Delhi, 1993
- Harris M, Tindall B, and Cox, Pharmaceutical Microbiology, 1st edition, 1964, The Williams and Wilkins, Baltimore, 1964.

5. Rose AH, Industrial Microbiology, 1st edition, Butterworths (Elsevier), Oxford, 1961.
6. Frobisher M, HinsDill RD, Crabtree KT, GoodHeart CR, Fundamentals of Microbiology, 9th edition, Japan, 1974.
7. Carter S.J., Cooper and Gunn's Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
8. Pepler HJ, Microbial Technology, 2nd Edition, Academic Press (Elsevier), Massachusetts, 1979.
9. I.P., B.P., U.S.P. - latest editions.
10. Reba Kanungo, Ananth Narayan and Paniker's Textbook of Microbiology, 10th Edition, Orient-Longman, Chennai, 2017.
11. Pommerville, J.C., Alcamo's Fundamentals of Microbiology, 3rd Edition, Jones and Bartlett, Burlington, Massachusetts, 2014.
12. Jain N.K, Pharmaceutical Microbiology, 3rd Edition, Vallabh Prakashan, Delhi, 2001.
13. Garry G.M., Bergey's Manual of Systematic Bacteriology, 2nd Edition, Springer publishing, New York, 2005.

BP304T

PHARMACEUTICAL ENGINEERING (Theory)

45 Hours

Course Objectives:

Study morphology, classification, and reproduction of all categories of microorganisms especially which cause diseases, microbiological tests, aseptic handling, and sterilization aspects.

Course Outcomes:

1. To understand mechanics of fluid, fluid flow and its measurements.
2. To know various unit operations used in pharmaceutical manufacturing and material handling systems.
3. To appreciate the various preventive methods used for corrosion control in pharmaceutical industries.
4. To define and categorize the different industrial hazards.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP304T CO1	3	2	1	2	1	2	1	1	1	2	3
BP304T CO2	3	2	2	3	1	1	1	1	1	2	3
BP304T CO3	3	1	1	2	1	1	1	1	1	2	3
BP304T CO4	3	2	3	1	1	2	1	2	1	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
	UNIT-I	10
1	Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer. Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors	

	affecting size reduction, principles, construction, working, uses, merits and demerits of Hammermill, ballmill, fluid energy mill, Edgerunnermill & endrunnermill. Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank. Material handling systems: Conveyers and Pumps	
	UNIT-II	10
2	• Heat and Mass Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. Temperature measurement-basic principles and devices. Mass transfer in turbulent and laminar flow. Concept of interfacial mass transfer. • Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator. • Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.	
3	UNIT-III	10
	• Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer, spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. • Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolid mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.	
4	UNIT-IV	8
	• Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seiditz filter. • Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semicontinuous centrifuge & supercentrifuge.	
5	UNIT-V	7
	• Materials of pharmaceutical plant construction, Corrosion, and its prevention: Factors affecting during materials selected for pharmaceutical plant construction, Theories of corrosion, types of corrosion and their prevention. Ferrous and non ferrous metals, inorganic and organic non-metals, basic of material handling systems. • Hazards: Sources of hazards in pharmaceutical industry and their prevention.	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Badger W.L. & Banchero J., Introduction to chemical engineering, Published by Tata McGraw Hill, International edition, New Delhi, 1955
2. Perry R.H., Green D.W., Maloney O., Perry's Chemical Engineer's Handbook - 7th Edition, McGraw Hill Inc., New York, 1998.
3. McCabe, Smith & Harriott. Unit Operations of Chemical Engineering, Published by McGraw Hill Inc., 5th edition, 1993.
4. Subramanyam C.V.S., Pharmaceutical Engineering: Unit Operations - Principles and Practice, Vallabh Prakashan, Delhi, 3rd edition, 2019.
5. Remington A., The Science & Practice of Pharmacy. Lippincott, Williams & Wilkins Philadelphia, 21st edition, 2006.
6. Lachman L., Lieberman H.A. & Kanig J.L., The Theory & Practice of Industrial Pharmacy, 3rd edition, Varghese Publishing House, Bombay, 1990.
7. K. Sambamurthy, Pharmaceutical Engineering, New Age International Publishers, Delhi, 2005
8. Subrahmanyam C.V.S., Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015.
9. Subrahmanyam C.V.S., Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017.
10. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
11. Sona P.S., A Practical Manual of Pharmaceutical Engineering, University Science Press, New Delhi, India.
12. Simpson N.J.K., Solid phase extraction, Principles, techniques, and applications, Marcel Dekker Inc. USA, 2000.

BP305P

PHARMACEUTICAL ORGANIC CHEMISTRY-II (Practical)

Course Objectives:

To get the learner introduced to the basic principles of organic synthesis.

Course Outcomes

The learners should be able to:

1. Remember/Understand the basic etiquettes of laboratory glassware, fire safety hazards and personal protection measures and follow good laboratory practices (GLP)
2. Apply the knowledge for selection of the appropriate solvents for recrystallization of organic compounds.
3. Determine and justify the significance of the analytical constants for fats and oils by titrimetric analysis.
4. Demonstrate and perform the melting point of synthesized pure compounds.
5. Explain the basic principles & procedures involved in the green chemistry and traditional techniques to prepare medicinal organic compounds.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP305P CO1	2	2	2	-	2	2	2	1	1	1	2
BP305P CO2	2	2	3	-	1	1	1	2	-	-	1
BP305P CO3	2	2	2	1	-	1	1	2	2	1	2
BP305P CO4	2	2	2	-	1	2	2	-	1	-	1
BP305P CO5	2	2	3	1	1	1	1	1	1	1	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong),

2(Moderate) and 1 (Weak). No relation -

I	Experiments involving laboratory techniques. - Recrystallization - Steam distillation
II	Determination of following oil values (including standardization of reagents). - Acid value - Saponification value - Iodine value
III	Preparation of compounds. - Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction. 2,4,6-Tribromoaniline/Parabromoacetanilide from Aniline/ - Acetanilide by halogenation (Bromination) reaction. 5-Nitrosalicylic acid/Metadinitrobenzene from Salicylic acid/Nitrobenzene by nitration reaction. - Benzoic acid from Benzyl chloride by oxidation reaction. - Benzoic acid/Salicylic acid from alkyl benzoate/alkyl salicylate by hydrolysis reaction. 1-Phenylazo-2-naphthol from Aniline by diazotization and coupling reactions. - Benzil from Benzoin by oxidation reaction. - Dibenzalacetone from Benzaldehyde by Claisen Schmidt reaction. - Cinnamic acid from Benzaldehyde by Perkin reaction. <i>P</i>-Iodobenzoic acid from <i>P</i>-aminobenzoic acid.

Reference Books (Latest Edition to be adopted):

- Morrison R.T., Boyd R.N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992.
- Finar I.L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963.
- Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017.
- Soni P.L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
- Mann F.G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York and Toronto, 1960.
- Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, 7. India, 1989.
- Vishnoi N.K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979.
- Engel R.G., Pavia D.L., Lampman G.N., Kriz G.S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010.

BP306P

PHYSICAL PHARMACEUTICS-I (Practical)

Course Objectives:

The objective of the course is to teach the learner the methods for the determination of different physical parameters underlying pre-formulation testing, formulation development and finished product testing of drug delivery systems.

Course Outcomes:

The learners should be able to:

- To understand the principles and methods for the determination of various physical parameters of drugs.
- To carry out various physico-tests involved in characterization of drugs.

3. To demonstrate testing of various physicochemical parameters involved in pre-formulation and formulation development and evaluation.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP306P CO1	3	1	2	1	1	2	1	1	1	1	3
BP306P CO2	3	2	2	1	1	2	2	2	1	1	3
BP306P CO3	3	2	2	1	1	2	2	2	1	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1	Determination of the solubility of drug at room temperature.
2	Determination of pK _a value by Half Neutralization/Henderson Hasselbalch equation.
3	Determination of Partition coefficient of benzoic acid in benzene and water.
4	Determination of Partition coefficient of Iodine in CCl ₄ and water (Demonstration).
5	Determination of CST of phenol-water system and % composition of NaCl in a solution using phenol-water system by CST method.
6	Determination of surface tension of given liquids by drop count and drop weight method.
7	Determination of HLB number of a surfactant by saponification method.
8	Determination of Freundlich and Langmuir constants using activated charcoal.
9	Determination of critical micellar concentration of surfactants.
10	Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method.
11	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method (Demonstration).
12	To determine the refractive index of liquids using Abbe's Refractometer.
13	To determine the concentration of an unknown solution of an optically active substance using polarimeter.
14	To determine the molecular weight of ionizable and non-ionizable solute by ebullioscopy (Landsberger Method).

Recommended Books (Latest Edition to be adopted):

1. Martin A, Swarbrick J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BIWaverly Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
3. Parrott E.L, Sasaki W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
5. Stocklosa M.J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman H.A, Lachman L, Schwartz J.B. Pharmaceutical dosage forms—tablets, Vol. 1, 2, 3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1,

Syllabus B.Pharm (PCI)



- 2,3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, Pharma Med Press, 2017
 9. C.V.S. Subramanyam, J. Thimmasettee, Laboratory Manual of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2014.
 10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
 11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017
 12. Jain G, Khar RK, Ahmad FJ, Theory and Practice of Physical Pharmacy, 1st Edition, Elsevier India, 2013
 13. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.

BP307P PHARMACEUTICAL MICROBIOLOGY (Practical)

Course Objectives:

To introduce the learner to some of the common techniques used in microbiological techniques and experiments.

Course Outcomes:

Upon completion of the course the student will be able to:

1. Characterization and identification of bacteria using various staining techniques (morphological study), colony characterization, serological and biochemical characteristics.
2. Analyze quality of raw material, food and water and assessment of extent of microbial contamination using counting technique and Evaluate sterility of products.
3. To impart the knowledge of bioassay of antibiotic and test antibiotic sensitivity of few antibiotics.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP307P CO1	3	3	3	3	1	3	3	1	3	3	3
BP307P CO2	3	3	3	3	1	3	3	1	3	3	3
BP307P CO3	3	3	3	3	1	3	3	1	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1	Introduction and study of different equipment and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2	Sterilization of glassware, preparation, and sterilization of media.
3	Subculturing of bacteria and fungus. Nutrient slabs and slants preparations.
4	Staining methods - Simple, Gram's staining and acid-fast staining (Demonstration with practical), negative staining, capsule staining, cell wall staining.
5	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6	Microbiological assay of antibiotics by cup plate method and other methods.



7	Motility determination by Hanging drop method.
8	Sterility testing of pharmaceuticals.
9	Bacteriological analysis of water.
10	Biochemical test.
11	Microbial Total counts by Breed's smear method (Demo), Microbial Growth by optical density, total plate count (Demo).

Recommended Books (Latest edition to be adopted):

1. Hugo W.B. and Russell A.D., Pharmaceutical Microbiology, 8th Edition, Blackwell Scientific Publications, Oxford, London, 2013.
2. Reed G., Prescott and Dunn's., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2004.
3. Pelczar MJ, Chan ECS, Kreig NR. Microbiology, 6th Edition, Tata McGraw Hill Education Pvt. Ltd, Delhi, 1993.
4. Harris M, Tindall B, and Cox, Pharmaceutical Microbiology, 1st edition, 1964, The Williams and Wilkins,
5. Rose AH, Industrial Microbiology, 1st edition, Butterworths (Elsevier), Oxford, 1961.
6. Frobisher M, Hinsdill RD, Crabtree KT, Good Heart CR, Fundamentals of Microbiology, 9th edition, Japan, 1974.
7. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
8. Peppler HJ, Microbial Technology, 2nd Edition, Academic Press (Elsevier), Massachusetts, 1979.
9. I.P., B.P., U.S.P. - latest editions.
10. Reba Kanungo, Ananth Narayan and Paniker's Textbook of Microbiology, 10th Edition, Orient-Longman, Chennai, 2017.
11. Pommerville, J.C., Alcamo's Fundamentals of Microbiology, 3rd Edition, Jones and Bartlett, Burlington, Massachusetts, 2014.
12. Jain N.K., Pharmaceutical Microbiology, 3rd Edition, Vallabh Prakashan, Delhi, 2001.
13. Garry G.M., Bergey's Manual of Systematic Bacteriology, 2nd Edition, Springer publishing, New York, 2005.

BP308PPHARMACEUTICAL ENGINEERING (Practical)

Course objectives:

To familiarize the learner with unit operations encountered in manufacturing of pharmaceuticals and provide training in operating and handling of instruments and equipment and an understanding of manufacturing processes.

Course Outcomes:

The learners should be able to:

1. Understand the construction and operation of various machines and equipment encountered in pharmaceutical manufacturing unit operations
2. Analyze various unit processes and factors involved to design and apply it to solve problems encountered in manufacturing
3. Understand and apply the calculation of various coefficients and variables that govern unit operation in order to maximize efficiency of the processes.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP308PCO1	3	3	3	3	3	3	3	3	2	3	3
BP308PCO2	3	3	3	3	3	3	3	3	2	3	3
BP308PCO3	3	3	3	3	3	3	3	3	2	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1	Determination of radiation constant of brass, iron, unpainted and painted glass.
2	Simple distillation – To calculate the efficiency of simple distillation.
3	Steam distillation – (Demonstration).
4	To determine the overall heat transfer coefficient by heat exchanger.
5	Construction of drying curves (for calcium carbonate and starch).
6	Determination of moisture content and loss on drying.
7	Determination of humidity of air – i) From wet and dry bulb temperatures – use of Dew point method.
8	Description of Construction working and application of pharmaceutical machinery such as fluid energy mill, dehumidifier.
9	Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.
10	Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
11	Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
12	Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/viscosity).
13	To study the effect of time on the Rate of Crystallization.
14	To calculate the uniformity Index for given sample by using Double Cone Blender.

Recommended Books: (Latest Edition to be adopted):

1. Badger W. L. & Banchero J., Introduction to chemical engineering, Published by Tata McGraw Hill, International edition, New Delhi, 1955
2. Perry R. H., Green D. W., Maloney O., Perry's Chemical Engineer's Handbook - 7th Edition, McGraw Hill Inc., New York, 1998.
3. McCabe, Smith & Harriott. Unit Operations of Chemical Engineering, Published by McGraw Hill Inc., 5th edition, 1993.
4. Subramanyam C. V. S., Pharmaceutical Engineering: Unit Operations - Principles and Practice, Vallabh Prakashan, Delhi., 3rd edition, 2019.
5. Remington A., The Science & Practice of Pharmacy. Lippincott, Williams & Wilkins Philadelphia. 21st edition, 2006.
6. Lachman L., Lieberman H. A. & Kanjig J. L., The Theory & Practice of Industrial Pharmacy, 3rd edition, Varghese Publishing House, Bombay, 1990.
7. K. Sambamurthy, Pharmaceutical Engineering, New Age International Publishers, Delhi, 2005.
8. C. V. S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015.

9. C.V.S Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, VallabhPrakashan, Delhi, 2017.
10. Carter S.J., Cooper and Gunn's Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
11. Sona P.S., A Practical Manual of Pharmaceutical Engineering, University Science Press, New Delhi, India.
12. Simpson N.J.K., Solid phase extraction, Principles, techniques, and applications, Marcel Dekker Inc. USA, 2000.

SEMESTER

IVBP401T

PHARMACEUTICAL ORGANIC CHEMISTRY–III(Theory)

45Hours

Course Objectives:

This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, and chemistry of important hetero cyclic compounds. It also emphasizes on the medicinal and other uses of organic compounds.

Course Outcomes:

At the end of the course, the students shall be able to:

1. **Illustrate** the stereo-chemical features including conformation and stereo electronic effects of organic molecules.
2. **Explain** the basic nomenclature and principles of heterocyclic chemistry.
3. **Predict** and Assign E&Z, R&S nomenclature of organic compounds.
4. **Apply** the mechanisms of organic reactions and common naming reactions in the synthesis of drug molecules.
5. **Explain** the structures and synthesis of simple five and six membered heterocyclic organic compounds.
6. **Predict** the formation of organic products from the starting materials and reactants and vice versa.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP401T CO1	2	2	2	1	1	1	-	1	-	-	1
BP401T CO2	2	-	2	2	-	-	-	-	-	-	2
BP401T CO3	2	-	2	2	-	-	-	-	-	-	2
BP401T CO4	2	2	2	-	-	1	1	1	1	-	1
BP401T CO5	2	2	2	1	-	1	1	1	1	-	1
BP401T CO6	2	1	2	-	-	1	-	1	-	-	1

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
	Note: To emphasize on definition, types, mechanisms, examples, uses/applications.	
1		10

	Stereoisomerism Optical isomerism– i. Optical activity, enantiomers, diastereoisomers, meso compounds. ii. Elements of symmetry, chiral and achiral molecules. iii. DL system of nomenclature of optical isomers, sequence rules, R/S system of nomenclature of optical isomers. iv. Reaction of chiral molecules (Stereo specific and stereoselective aspects). v. Racemic modification and resolution of racemic mixture. vi. Asymmetric synthesis: partial and absolute.	
2		10
	Geometrical isomerism i. Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems). ii. Methods of determination of configuration of geometrical isomers. iii. Conformational isomerism in Ethane, n-Butane and Cyclohexane. iv. Stereoisomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.	
3		10
	Heterocyclic compounds: Nomenclature and classification. Synthesis, reactions and medicinal uses of following compounds/derivatives. Pyrrole, Furan, and Thiophene. Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene.	
4		08
	Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine. Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives.	
5	Reaction of synthetic importance	07
5.1	Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.	2
5.2	Oppenauer-oxidation and Dakin reaction.	2
5.3	Beckmann rearrangement and Schmidt rearrangement.	2
5.4	Claisen-Schmidt condensation.	1
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Finar I.L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963
2. Bahl B.S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
3. Bansal R.K., Heterocyclic Chemistry, 4th edition, Anshan Limited, India, 2008
4. Morrison R.T., Boyd R.N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992
5. Gilchrist T.L., Heterocyclic Chemistry, 3rd edition, Prentice Hall, New Jersey, 1997

BP402T

MEDICINAL CHEMISTRY – I (Theory)

45 Hours

Course Objectives:

This subject is designed to impart fundamental knowledge on the structure, chemistry, and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Course Outcomes:

Upon completion of the course the student shall be able to:

1. Understand the chemistry of drugs with respect to their pharmacological activity.
2. Understand and predict the drug metabolic pathways, adverse effect, and therapeutic value of drugs.
3. Critically examine and evaluate the structure-activity relationships of selected classes of drugs specified in the course, demonstrating a deep understanding of how molecular structures influence drug interactions and effectiveness.
4. Know and analyze the Structural Activity Relationship (SAR) of different class of drugs
5. Outline the chemical synthesis of some drugs.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP402T CO1	2	2	3	-	1	1	1	2	1	-	2
BP402T CO2	2	2	3	-	-	1	-	1	2	-	2
BP402T CO3	2	1	3	1	-	1	-	-	-	-	2
BP402T CO4	2	1	3	1	-	1	-	1	-	-	1
BP402T CO5	2	2	2	1	-	1	1	1	1	-	1

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted*.	
1	Introduction to Medicinal Chemistry	10
1.1	History and development of medicinal chemistry	1
1.2	Physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.	4
1.3	Drug metabolism • Drug metabolism principles-Phase I and Phase II. • Factors affecting drug metabolism including stereochemical aspects.	5
2	Drugs acting on Autonomic Nervous System	10
2.1	Adrenergic Neurotransmitters: • Biosynthesis and catabolism of catecholamine. • Adrenergic receptors (Alpha & Beta) and their distribution.	2
2.2	Sympathomimetic agents: SAR of Sympathomimetic agents • Direct acting: Norepinephrine, Epinephrine, Phenylephrine*, Dopamine. • Methyl dopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. • Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. • Agents with mixed mechanism: Ephedrine, Metaraminol.	4

2.3	AdrenergicAntagonists: • Alphaadrenergicblockers:Tolazoline*,Phentolamine,Phenoxybenzamine,Pr azosin,Dihydroergotamine,Methysergide. • Betaadrenergicblockers:SARofbetablockers,Propranolol*,Metibranolol,Ate nolol,Betazolol,Bisoprolol,Esmolol,Metoprolol,Labetolol,Carvedilol.	4
3	Cholinergicneurotransmitters	10
3.1	Biosynthesisandcatabolismofacetylcholine. Cholinergicreceptors(Muscarinic&Nicotinic)andtheirdistribution	2
3.2	Parasympathomimeticagents:SARofParasympathomimeticagents • Directactingagents:Acetylcholine,Carbachol*,Bethanechol,Methacholine,Pil ocarpine. • Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrinehydrochloride, Ambenonium chloride, Isoflurophate, Echothiophate iodide,Parathione,Malathion. • Cholinesterasereactivator:Pralidoximechloride.	4
3.3	CholinergicBlockingagents:SARofcholinolyticagents • Solanaceousalkaloidsandanalogues:Atropinesulphate,Hyoscyaminesulphate, Scopolaminehydrobromide,Homatropinehydrobromide,Ipratropiumbromide*. • Syntheticcholinergicblocking agents: Tropicamide,Cyclopentolatehydrochloride, Clidinium bromide, Dicyclomine hydrochloride*,Glycopyrrolate,Methanthelinebromide,Propanthelinebromide ,Benzotropinemesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidinehydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazinehydrochloride.	4
4	DrugsactingonCentralNervousSystem	08
4.1	SedativesandHypnotics: • Benzodiazepines:SARofBenzodiazepines,Chlordiazepoxide,Diazepam*,O xazepam,Chlorazepate,Lorazepam,Alprazolam,Zolpidem. • Barbiturates:SARofbarbiturates,Barbital*,Phenobarbital,Mephobarbital,A mobarbital,Butabarbital, Pentobarbital,Secobarbital. • Miscellaneous: Amidesandimides:Glutethimide. Alcohol&their carbamatederivatives:Meprobamate,Ethchlorvynol. Aldehyde&theirderivatives:Triclofossodium,Paraldehyde.	3
4.2	Antipsychotics • Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride,Chlorpromazinehydrochloride*,Triflupromazine,Thioridazineh ydrochloride,Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazinehydrochloride. • RingAnaloguesofPhenothiazines:Chlorprothixene,Thiothixene,Loxapinesuc cinate,Clozapine. • Fluorobuterothenones:Haloperidol,Droperidol,Risperidone. • Betaaminoketones:Molindonehydrochloride. • Benzamides:Sulpiride.	3

Syllabus B.Pharm (PCI)



4.3	Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action • Barbiturates: Phenobarbitone, Methobarbital. • Hydantoins: Phenytoin*, Mephenytoin, Ethotoin. • Oxazolindiones: Trimethadione, Paramethadione. • Succinimides: Phensuximide, Methsuximide, Ethosuximide* • Urea and monoacylureas: Phenacemide, Carbamazepine* • Benzodiazepines: Clonazepam. • Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate.	2
5	Drugs acting on Central Nervous System	07
5.1	General anesthetics: • Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. • Ultrashort acting barbiturates: Methohexital sodium*, Thiopental sodium, Thiopental sodium. • Dissociative anesthetics: Ketamine hydrochloride.*	3
5.2	• Narcotic and non-narcotic analgesics • Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anileridine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartrate. • Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartrate, Naloxone hydrochloride.	2
5.3	Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	2
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Beale J.M., Block J.H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T.L., Williams D.A., Roche V.F., Zito, S.W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001.
3. Abraham D.J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003.
4. Smith H.J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005.
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
6. Robert Buckingham, Martindale: The Extra Pharmacopoeia, 40th edition, Pharmaceutical Press, 2020.
7. Finar I.L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicher D., The Organic Chemistry of Drug Synthesis, Vol. 1-7, Wiley-Blackwell, 2007
9. Indian Pharmacopoeia.
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989.

BP403T

PHYSICAL PHARMACEUTICS-II(Theory)

45 Hours

Course objectives:

The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Course Outcomes:

The learner should be able to:

1. **Describe**, compare, and correlate the laws of thermodynamics, Concept of enthalpy, entropy and free energy, Gibbs equation, thermochemistry.
2. **Understand** the concept of Suspension, Emulsions, Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.
3. **Apply** knowledge of dispersed systems & their general characteristics, Optical, kinetic & electrical properties as well as effect of electrolytes, coacervation, peptization & protective action.
4. **Understanding** of Newtonian system and non-Newtonian system, Plastic and elastic deformation, Hooke's equation, Stress, Strain, Elastic Modulus.
5. **Understanding** of the concept of micromeritics, methods for determining particle size by different methods and derived properties of powders.
6. **Understanding** of the concept of Reaction kinetics, zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP403T CO1	3	2	3	3	-	2	3	2	3	3	3
BP403T CO2	3	2	3	3	-	2	3	2	3	3	3
BP403T CO3	3	2	3	3	-	2	3	2	3	3	3
BP403T CO4	3	2	3	3	-	2	3	2	3	3	3
BP403T CO5	3	2	3	3	-	2	3	2	3	3	3
BP403T CO6	3	2	3	3	-	2	3	2	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	5
	Thermodynamics: First law and second law of thermodynamics; Concept of enthalpy, entropy and free energy, Gibbs equation, thermochemistry.	
2	UNIT-II	8
	Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.	

3	UNIT-III	7
	Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coagulation, peptization & protective action.	
4	UNIT-IV	7
	Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers.	
	Deformation of solids: Plastic and elastic deformation, Hooke's equation, Stress, Strain, Elastic Modulus	
5	UNIT-V	8
	Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	
6	UNIT-VI	10
	Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.	
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly. Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
5. Stocklosa M.J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol. 1, 2, 3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.

8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, Pharma Med Press, 2017
9. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.
10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017

BP404T

PHARMACOLOGY-I(Theory)

45Hours

Course Objectives:

The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject will impart information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism, and excretion (pharmacokinetics), routes of administration of different classes of drugs along with their adverse effects, clinical uses, interactions, doses and contraindications that can be bridged to the clinical settings.

Course Outcomes:

Upon completion of this course the students should be able to

1. Understand the pharmacological actions of different categories of drugs and comprehend the pharmacokinetic and pharmacodynamic principles.
2. Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
3. Understand autonomic transmission and discuss the pharmacology of drugs acting on ANS and rationalize their therapeutic applications.
4. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
5. Explain the features of adverse drug reactions and drug interactions and appreciate correlation of pharmacology in biomedical disciplines like drug discovery and pharmacovigilance.

Mapping CO-PO:

BP404T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	2	3	3	2	3	-	3
CO2	3	2	3	3	2	3	3	2	3	-	3
CO3	3	2	3	3	2	3	3	2	3	-	3
CO4	3	2	3	3	2	3	3	2	3	-	3
CO5	3	2	3	3	2	3	3	2	3		3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	General Pharmacology	8

Syllabus B.Pharm (PCI)



1.1	Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non-competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy and teratogenicity.	4
1.2	Pharmacokinetics- Membrane transport, absorption, distribution, metabolism, and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination.	4
2	General Pharmacology	12
2.1	Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors, drug receptors interaction on signal transduction mechanisms, G-protein-coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.	6
2.2	Adverse drug reactions.	2
2.3	Drug interactions (pharmacokinetic and pharmacodynamic).	2
2.4	Drug discovery and clinical evaluation of new drugs- Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	2
3	Pharmacology of peripheral nervous system	10
3.1	Organization and function of ANS, Neurohumoral transmission, co-transmission and classification of neurotransmitters.	1
3.2	Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.	3
3.3	Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).	2
3.4	Local anesthetic agents.	3
3.5	Drugs used in myasthenia gravis and glaucoma.	1
4	Pharmacology of central nervous system	08
4.1	Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.	1
4.2	General anesthetics and pre-anesthetics.	2
4.3	Sedatives, hypnotics and centrally acting muscle relaxants.	2
4.4	Anti-epileptics.	2
4.5	Alcohol and disulfiram.	1
5	Pharmacology of central nervous system	07
5.1	Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.	2
5.2	Drugs used in Parkinson's disease and Alzheimer's disease.	1
5.3	CNS stimulants and nootropics.	1
5.4	Opioid analgesics and antagonists.	2
5.5	Drug addiction, drug abuse, tolerance and dependence.	1
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Ritter J.M., Flower R.J., Henderson G., Loke Y., MacEwan D., Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
- Katzung B.G., Masters S.B., Trevor A.J., Basic and Clinical Pharmacology, 14th edition, Tata McGraw-

Hill Education, Pvt. Ltd, 2017

3. Brunton, L.L., Hilal-Dandan R., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G.B., Wayne A.K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
6. Harvey R., Clark M.A., Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
7. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
8. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
9. Craig C.R., Stitzel, R.E, Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
10. Ghosh M.N. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
11. Kulkarni S.K. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
12. Walker R., Edwards, Clinical Pharmacy and Therapeutics, 3rd edition, Churchill Livingstone Edinburgh, New York, 2003.
13. Tipnis and Bajaj, Clinical Pharmacy, 3rd edition, Career Publications, Nasik, 2017.
14. Bennett P.N., Brown M.J., Clinical Pharmacology, 12th edition, Elsevier, Edinburg, 2019.
15. Parthasarathi G., Nyfort-Hansen K., Nahata M. C., 1st edition, Textbook of Clinical Pharmacy
16. Practice; Essential Skills and Concepts, Orient Longman Pvt, Ltd, Hyderabad, 2004.

BP405T

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

45 Hours

Course Objectives:

The subject

involves the fundamentals like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Understand the scope and relevance of Pharmacognosy in various systems of medicine
2. Evaluate the significance of various sources and methods of classification of drugs of natural origin
3. Apply the various evaluation techniques in quality control of drugs of natural origin
4. Understand the techniques involved in and factors affecting conventional and modern techniques of cultivation and production of crude drugs
5. Understand the chemistry of various phytoconstituent classes and connect it to their physical properties and identification tests
6. Understand chemistry and physical properties of drugs containing primary metabolites and evaluate their therapeutic applications.

Mapping CO-PO:

BP405T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	1	1	3	3	2	3	3	3	3
CO2	3	2	3	2	1	3	1	3	2	3	3
CO3	3	2	3	3	1	3	3	3	3	3	3

Syllabus B.Pharm (PCI)



CO4	3	1	3	3	2	3	2	3	3	3	3
CO5	3	1	3	3	1	3	2	3	2	3	3
CO6	3	1	3	3	2	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1		10
1.1	Introduction to Pharmacognosy: (a) Definition, history, scope and development of Pharmacognosy, (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture, (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo-gum-resins).	3
1.2	Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemical and serological classification of drugs.	2
1.3	Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical, and biological methods and properties. Quantitative microscopy of crude drugs including glycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	5
2		12
2.1	Cultivation, Collection, Processing, and storage of drugs of natural origin: Cultivation and Collection of drugs of natural origin, Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation, and hybridization with reference to medicinal plants,	10
2.2	Conservation of medicinal plants	2
3		7
	Plant tissue culture: Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth, and their maintenance.	
	Application of plant tissue culture in pharmacognosy. Edible vaccines.	
4		10
4.1	Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.	3
4.2	Introduction to secondary metabolites: Definition, classification, properties, and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins.	7
5	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs	08
	(a) Plant Products: Fibers-Cotton, Jute, Hemp. Hallucinogens, Teratogens, Natural allergens.	3

	(b) Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: (c) Carbohydrates: Acacia, Agar, Tragacanth, Honey. (d) Proteins and Enzymes: Gelatin, casein, proteolytic enzymes (Papain, bromelain, serine protease, urokinase, streptokinase, pepsin).	3
	(e) Lipids (Waxes, fats, fixed oils): Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax (f) Marine Drugs: Novel medicinal agents from marine sources.	2
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J & A Churchill Ltd, London, 2005.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi, 2018 reprint.
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A.P., Gokhale S.B., Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, Pharma Med Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
10. Khandelwal K.R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.
11. Vasudevan T.N. Laddha K.S, Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
12. Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.

BP406P MEDICINAL CHEMISTRY-I (Practical)

Course Objectives:

To get the learner introduced to the basic principles of organic synthesis.

Course Outcomes

The learners should be able to:

1. Remember/Understand the basic etiquettes of laboratory glassware, fire safety hazards and personal protection measures and follow good laboratory practices (GLP)
2. Analyze and determine the purity of drugs present in the bulk and dosage forms.
3. Determine the partition coefficient of pharmaceutical agents.
4. Outline the synthesis of intermediate compounds and drugs of medicinal importance.
5. Explain the basic principles, mechanisms and procedures involved in green chemistry and traditional techniques

to prepare medicinal organic compounds.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP406P CO1	2	2	2	-	2	2	2	1	1	1	2
BP406P CO2	2	2	3	1	-	1	1	1	-	-	2
BP406P CO3	2	1	3	1	1	1	1	1	-	-	2
BP406P CO4	2	2	2	1	-	1	1	1	1	-	1
BP406P CO5	2	2	3	1	1	1	1	1	1	1	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

A. Preparation of drugs/intermediates	
1,3-pyrazole.	
1,3-oxazole.	
Benzimidazole.	
Benzotriazole.	
2,3-diphenylquinoxaline.	
Benzocaine.	
Phenytoin.	
Phenothiazine.	
Barbiturate.	
B. Assay of drugs	
Chlorpromazine.	
Phenobarbitone.	
Atropine.	
Ibuprofen.	
Aspirin.	
Furosemide.	
C. Determination of Partition coefficient for any two drugs	

Reference Books (Latest Edition to be adopted):

1. Beale J.M., Block J.H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T.L., Williams D.A., Roche V.F., Zito, S.W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001
3. Abraham D.J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003
4. Smith H.J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005
6. Robert Buckingham, Martindale: The Extra Pharmacopoeia, 40th edition, Pharmaceutical Press, 2020.
7. Finar I.L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicer D., The Organic Chemistry of Drug Synthesis, Vol. 1-7, Wiley-Blackwell, 2007
9. Indian Pharmacopoeia
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989

BP407P PHYSICAL PHARMACEUTICS-II(Practical)

Course Objectives:

To familiarize the learner with methods to evaluate particle size, and flow properties, shelf life and physical stability of solutions and suspensions and teach the learner characterization methods and protocols for determination of physical parameters.

Course Outcomes:

The learners should be able to:

1. Determine reaction rate constant, order of reaction for different reactions.
2. Predict shelf life by carrying out accelerated stability studies.
3. Calculate physical parameters such as stability constants, particle size, density, flow properties, molecular weight, viscosity, and sedimentation rate.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP407P CO1	3	3	3	3	3	3	2	3	2	3	3
BP407P CO2	3	3	3	3	3	3	2	3	2	3	3
BP407P CO3	3	3	3	3	3	3	2	3	2	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

LIST OF EXPERIMENTS

1	Determination of particle size, particle size distribution using sieving method.
2	Determination of particle size, particle size distribution using microscopic method.
3	Determination of bulk density, true density, and porosity.
4	Determine the angle of repose and influence of lubricant on angle of repose.
5	Determination of viscosity of liquid and concentration of unknown using Ostwald's viscometer.
6	Determination of sedimentation volume with the effect of different suspending agent.
7	Determination of sedimentation volume with effect of different concentration of single suspending agent.
8	Determination of viscosity of semi-solid by using Brookfield viscometer (Demonstration).
9	Determination of reaction rate constant first order and determine relative strength of acids.
10	Determination of reaction rate constant second order (both $a=b$ and $a \neq b$).
11	Accelerated stability studies and determination of shelf life.
12	Determination of order of reaction using Ostwald Isolation Method (Demonstration).
13	Determination of molecular weight of polymer using Intrinsic viscosity.

Reference Books (Latest Edition to be adopted):

1. Martin A, Swarbrick J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New

Delhi, 2005.

5. Stocklosa M.J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol. 1, 2, 3 edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Lieberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, Pharma Med Press, 2017.
9. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.
10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017

BP408P **PHARMACOLOGY I (Practical)**

Course Objectives:

The course will impart training in basic laboratory techniques, instruments, and regulatory and ethical guidelines applicable in experimental pharmacology. The students will be appraised on animal handling techniques, routes of administration, anesthesia and pharmacological effects of various drugs using simulated audio-visual techniques.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Possess the knowledge of animals and instruments used in pharmacology.
2. Relate to and apply the regulatory and ethical guidelines in drug/lead testing using preclinical animals.
3. Describe the animal handling techniques and procedures used in animal experimentation.
4. Observe the effect of drugs on animals by simulated experiments and interpret the pharmacological actions.

Mapping CO-PO:

BP408P <i>Course Outcomes</i>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum, and plasma separation, anesthetics

and euthanasia used for animal studies.

6. Study of different routes of drug administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effect of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotypic and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by software and videos

Reference Books (Latest Edition to be adopted):

1. Ritter J.M., Flower R.J., Henderson G., Loke Y., MacEwan D., Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
2. Katzung B.G., Masters S.B., Trevor A.J., Basic and Clinical Pharmacology, 14th edition, Tata Mc Graw-Hill Education, Pvt. Ltd, 2017
3. Brunton, L.L., Hilal-Dandan R., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
4. Marry Anne K.K., Lloyd Yee Y., Brian K.A., Robbin L.C., Joseph G.B., Wayne A.K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
6. Harvey R., Clark M.A., Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
7. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
8. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
9. Craig C.R., Stitzel, R.E, Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
10. Ghosh M.N.
Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
11. Kulkarni S.K. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
12. Satoskar R.S., Bhandarkar S.D., Tripathi, R.K., Rege N.N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
13. Kasture, S.B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.
14. Perry W. L. M., Pharmacological Experiments on isolated preparations, 1st edition, E & S Livingstone, Edinburgh & London, 1968.

BP409P

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

Course Objectives:

The subject involves identification and evaluation of crude drugs, phytochemicals present in them and their medicinal properties.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Analyze the crude drugs, by chemical tests.
2. Assess quality of crude drugs by qualitative and quantitative microscopic techniques.
3. Evaluate crude drugs by physical tests.

CO-PO Mapping

BP409P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii) Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil.
2. Determination of stomatal number and index.
3. Determination of vein islet number, vein islet termination and palisade ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eyepiece micrometer.
5. Determination of Fiber length and width.
6. Determination of number of starch grains by Lycopodium spore method.
7. Determination of Ash value.
8. Determination of Extractive values of crude drugs.
9. Determination of moisture content of crude drugs.
10. Determination of swelling index and foaming.

Reference Books (Latest Editions to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J & A Churchill Ltd, London, 2005.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi, 2018 reprint.
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi, 1996
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A. P., Gokhale S.B., Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, Pharma Med Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
10. Khandelwal K.R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.

11. Vasudevan T.N., Laddha K.S., Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987
12. Shah B.A., Seth A., Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A Division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.

SEMESTER V

BP501T

MEDICINAL CHEMISTRY –II(Theory)

45Hours

Course Objectives:

This course is designed to impart fundamental knowledge on the structure, chemistry, and therapeutic value of drugs. The course is designed to include the structure-activity relationships of drugs, importance of physicochemical properties of drugs, metabolism of drugs, and chemical synthesis of important drugs under each class.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Understand the chemistry of drugs and their relation to their pharmacological activities.
2. Become proficient in the classification and mechanisms of action of drugs used as antineoplastics, antihistamines, antianginals, antihypertensive, anti-hyperlipidemics and steroidal molecules.
3. Predict the drug metabolic pathways, adverse effect, and therapeutic value of drugs
4. Analyze and evaluate the Structural Activity Relationship of different class of drugs.
5. Demonstrate proficiency in outlining the chemical synthesis of selected drugs.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP501T CO1	2	2	3	-	1	1	1	2	1	-	2
BP501T CO2	2	1	3	-	-	1	-	1	1	-	2
BP501T CO3	2	2	3	-	-	1	-	1	2	-	2
BP501T CO4	2	1	3	1	-	1	-	1	-	-	1
BP501T CO5	2	2	2	1	-	1	1	1	1	-	1

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure-activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*).	10
1	UNIT-I	

1.1	Antihistaminic agents: Histamine, receptors, and their distribution in the human body. H₁-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylaminesuccinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripeleminaminehydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizinehydrochloride, Chlorpheniraminemaleate, Triprolidinehydrochloride*, Phenidaminetartarate, Promethazinehydrochloride*, Trimeprazinetrartrate, Cyproheptadinehydrochloride, Azatidinemaleate, Astemizole, Loratadine, Cetirizine, Levocetirizine, Cromolynsodium H₂-antagonists: Cimetidine*, Famotidine, Ranitidine.	4
1.2	Gastricprotonpumpinhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole	1
1.3	Anti-neoplasticagents: Alkylating agents: Mechlorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa, Cisplatin Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine. Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Mitoxantrone, Bleomycin. Plant products: Etoposide, Vinblastine sulphate, Vincristine sulphate, Taxol, Camptothecin. TyrosineKinaseInhibitorsandHDACinhibitors	5
2	UNIT-II	10
2.1	Anti-anginal: Vasodilators: Amyl nitrite, Nitroglycerine*, Pentaerythritol tetranitrate, Isosorbidedinitrate*, Dipyridamole. Calciumchannelblockers: Verapamil, Bepridilhydrochloride, Diltiazemhydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. Diuretics: Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide. Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride. OsmoticDiuretics: Mannitol.	7
2.2	Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazeprilhydrochloride, Quinaprilhydrochloride, Methyl dopatehydrochloride, *Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodiumnitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazinehydrochloride.	3
3	UNIT-III	10
3.1	Anti-arrhythmic Drugs: Quinidine sulphate, Procainamidehydrochloride, Disopyramidephosphate*, Phenytoinsodium, Lidocainehydrochloride, Tocainide hydrochloride, Mexiletinehydrochloride, Lorcaidinehydrochloride, Amiodarone, Sotalol.	4

Syllabus B.Pharm (PCI)



3.2	Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholestyramine and Colestipol.	2
3.3	Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, Clopidogrel.	2
3.4	Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.	2
4	UNIT-IV	08
4.1	Drugs acting on Endocrine system Nomenclature, Stereochemistry, and metabolism of steroids.	2
4.2	Sex hormones: Testosterone, Nandrolone, Progesterone, Estrinol, Estradiol, Estrone, Diethylstilbestrol.	1
4.3	Drugs for erectile dysfunction: Sildenafil, Tadalafil.	1
4.4	Oral contraceptives: Mifepristone, Norgestrel, Levonorgestrel.	1
4.5	Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone.	2
4.6	Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	1
5	UNIT-V	07
5.1	Antidiabetic agents: Insulin and its preparations. Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acarbose, Voglibose. GLP agonists, DPP-IV inhibitors	2
5.2	Local Anaesthetics: Benzoic Acid derivatives: Cocaine, Hexylcaine, Mepylcaine, Cyclomethycaine, Pipercaine. Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. Miscellaneous: Phenacaine, Dipreron, Dibucaine.*	5
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Beale J. M., Block J. H., Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
- Lemke T. L., Williams D. A., Roche V. F., Zito, S. W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001.
- Abraham D. J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003.
- Smith H. J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005.
- Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
- Robert Buckingham, Martindale: The Extra Pharmacopoeia, 40th edition, Pharmaceutical Press, 2020.

7. Finar I.L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963.
8. Lednicher D., The Organic Chemistry of Drug Synthesis, Vol. 1-7, Wiley-Blackwell, 2007.
9. Indian Pharmacopoeia.
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989.

BP502T INDUSTRIAL PHARMACY I (Theory) 45 Hours

Course Objective:

This course is designed to prepare the students for career in the pharmaceutical industry by providing them with comprehensive understanding of industrial operations, quality control, regulatory compliance and the scientific principles behind dosage form development and manufacturing.

Course Outcomes:

The learner should be able to:

1. Understand and apply the knowledge of preformulation in development of pharmaceutical dosage forms.
2. Apprise the formulation aspects of tablets, coating and liquid orals and demonstrate their quality of finished dosage forms.
3. Know and apply the manufacturing, formulation and packaging aspects of hard, soft gelatin capsules and pellets.
4. Describe the preformulation and formulation aspects of parenteral and ophthalmic preparations, large scale production procedures, production facilities and quality control.
5. Summarize the formulation and quality control of cosmetic products and aerosols and know the packaging aspects of pharmaceutical products.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP502T CO1	3	3	3	1	-	2	3	2	3	3	3
BP502T CO2	3	3	3	3	-	2	3	2	3	3	3
BP502T CO3	3	3	3	2	-	2	3	2	3	3	3
BP502T CO4	3	3	3	2	-	2	3	2	3	3	3
BP502T CO5	3	3	3	2	-	2	3	2	3	3	3
BP403T CO6	3	2	3	3	-	2	3	2	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT -I-Preformulation Studies	7
1.1	Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.	1
1.2	Physical properties: Solid state properties – crystalline and amorphous, polymorphism, particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), lipophilicity.	2



1.3	Stability–Chemical: a) Hydrolysis,oxidation,reduction,decarboxylation,racemisation,polymerization,H ygroscopicity,Lossofmoisture,Lossofvolatilecomponents,Excipientcompatibility,P ackage(container&closure)compatibility. b) Biopharmaceuticalconsiderations- Dissolution&Permeation;BCSclassificationofdrugs.	2
1.4	Applicationofpreformulationconsiderations inthedevelopmentofsolid,liquidoralandparenteraldosageformsanditsimpactonstabil ityofdosageforms.	2
2	UNIT-II	10
2.1	Tablets a. Introduction,idealcharacteristicsoftablets,classificationoftablets.Excipients,For mulationoftablets,granulation methods,compression,andprocessingproblems.Equipmentandtabletooling.Packag ingof tablets. b. Tablet coating: Types of coating, coating materials, formulation of coatingcomposition, methodsofcoating,equipmentemployedanddefectsincoating. c. Qualitycontroltests:Inprocessandfinishedproducttests. d. Layoutoftabletsection.	8
2.2	Liquid orals: Formulation and large-scale manufacturing consideration of solutions, suspensions and emulsions; Filling and packaging; evaluation of liquidoralofficialinpharmacopoeia.Layoutof liquidsection	2
3	UNIT-III	8
3.1	Hard gelatin capsules: Introduction, Extraction of gelatin and production of hardgelatin capsule shells. size of capsules, Types of Capsule fill formulations; Fillingoperation,finishingandspecialtechniques offormulationofhardgelatincapsules.Other polymers used for Hard Capsule shells - like HPMC, Carageenan andAlginates Packagin, Storage and In process and final product quality control tests for rawmaterialsandcapsules.Layoutof capsulesection.	3
3.2	Soft gelatincapsules: Definitionanduses.Natureofshellandcapsulecontent,sizeofcapsules,f ormulationconsiderationsandimportanceofbaseadsorptionand minimum/gram factors, production, in process and final product quality controltests.Packing,storageandstabilitytestingof softgelatincapsules.	3
3.3	Pellets: Introduction, formulation requirements, pelletization process, equipmentformanufactureofpellets.	2
4	UNIT-IV	10
4.1	Parenteral Preparations: Definition, types, routes of administration, advantagesandlimitations.Preformulationfactorsand essentialrequirements,vehicles, additives, importance of isotonicity. Preparation of water for injection and pyrogencontrol.	2
4.2	Large-scaleProductionprocedure,productionfacilitiesandcontrols.Layout andcontrols;HVAC;ClassificationofCleanRoomsandasepticprocessing	1
4.3	Formulation of injections, sterile powders, emulsions, suspensions, large volumeparenterals andlyophilizedproducts,Sterilizationmethods(revision).	3
4.4	Containersandclosuresselection, fillingandsealingofampoules,vialsandinfusionfluids.InprocessandQualitycontrolte stsforinjectables.	1

Syllabus B.Pharm (PCI)



4.5	Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations.	3
5	UNIT-V	10
5.1	Cosmetics: Formulation and preparation of the following cosmetic preparations: Lipsticks, nail lacquers, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.	3
5.2	Pharmaceutical Aerosols: Definition, propellants, containers, valves, actuators, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.	3
5.3	Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.	4
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
- Lieberman H.A, Lachman L, Pharmaceutical dosage forms. Parenteral Medications, volume 1,2,3/edited by Avis K, Herbert A. Lieberman H. A. and Lachman L, Martin, M., 3rd edition, Marcel Dekker Inc. New York. 1993.
- Lieberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
- Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 4th Edition. Marcel Dekker, 2002.
- Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
- Lachman, L, Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, 1st edition, Lea & Febiger, Philadelphia, 1986.
- Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.
- Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Wilkins, US A, 2014.
- Drug stability- Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.
- Salvatore J. Turco, Sterile dosage forms: their preparation and clinical applications, 4th edition, Wolters Kluwer India Pvt. Ltd, 2011.
- R.G. Harry, J.B. Wilkinson and R.J. Moore, Harry's Cosmeticology, 7th edition, Longman Scientific & Technical Publishers, 1994.
- M.S. Balsam, E. Sagarin, S.D. Gerhon, S.J. Strianse and M.M. Rieger, Cosmetics Science and Technology, Volumes 1, 2 and 3. Wiley-Interscience, Wiley India Pvt. Ltd.
- Hilda Butler, Poucher's Perfumes, cosmetics & Soaps, 10th edition, Kluwer Academic Publishers, Netherlands, 2000.
- BIS Guidelines for different cosmetic products.
- Hanlon J., Robert J. Kelsey, "Handbook of Package Engineering" 2nd Edition, McGraw-Hill, New York. 1984.
- Paine A., Packaging User's Handbook, 1st edition, Springer, 2019.

Course Objectives:

This course is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition explain the basic concepts of bioassay.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Understand the mechanism of drug action and its relevance in the treatment of different diseases.
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments.
3. Demonstrate the various receptor actions using isolated tissue preparation.
4. Appreciate the correlation of pharmacology with related medical sciences.

Mapping CO-PO:

BP503T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	2	3	3	2	3		3
CO2	3	2	3	3	2	3	3	2	3		3
CO3	3	2	3	3	2	3	3	2	3		3
CO4	3	2	3	3	2	3	3	2	3		3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

Unit	Details	Hours
1	UNIT-I	10
	Pharmacology of drugs acting on cardiovascular system a. Introduction to hemodynamic and electrophysiology of heart. b. Drugs used in congestive heart failure. c. Anti-hypertensive drugs. d. Anti-anginal drugs. e. Anti-arrhythmic drugs. f. Anti-hyperlipidemic drugs.	
2	UNIT-II	10
2.1	Pharmacology of drugs acting on cardiovascular system a. Drug used in the therapy of shock. b. Haematinics, coagulants and anticoagulants. c. Fibrinolytics and anti-platelet drugs. d. Plasma volume expanders.	6
2.2	Pharmacology of drugs acting on urinary system a. Diuretics. b. Anti-diuretics.	4
3	UNIT-III	10

Syllabus B.Pharm (PCI)



	Autocoids and related drugs a. Introduction to autocoids and classification. b. Histamine, 5-HT and their antagonists. c. Prostaglandins, Thromboxanes and Leukotrienes. d. Angiotensin, Bradykinin and Substance P.	
	e. Non-steroidal anti-inflammatory agents. f. Anti-gout drugs. g. Cytokines h. Histamine, 5-HT and their antagonists. i. Prostaglandins, Thromboxanes and Leukotrienes. j. Angiotensin, Bradykinin and Substance P. k. Non-steroidal anti-inflammatory agents. l. Antirheumatic drugs.	
4	UNIT-IV	08
	Pharmacology of drugs acting on endocrine system a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones-analogues and their inhibitors. c. Thyroid hormones-analogues and their inhibitors. d. Hormones regulating plasma calcium level - Parathormone, calcitonin and Vitamin-D. e. Insulin, Oral Hypoglycemic agents and glucagon. f. ACTH and corticosteroids.	
5	UNIT-V	07
5.1	Pharmacology of drugs acting on endocrine system a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus.	4
5.2	Bioassays a. Principles and applications of bioassays. b. Types of bioassays. c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT.	3
	TOTAL	45

Reference Books (Latest Edition to be adopted):

- Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, 9th edition, Churchill Livingstone Elsevier, 2019.
- Ritter J. M., Flower R. J., Henderson G., Loke Y., MacEwan D., Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
- Katzung B. G., Masters S. B., Trevor A. J., Basic and Clinical Pharmacology, 14th edition, Tata McGraw-Hill Education, Pvt. Ltd, 2017
- Brunton, L. L., Hilal-Dandan R., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
- Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L. C., Joseph G. B., Wayne A. K., Bradley R. W., Applied Therapeutics, The Clinical Use of Drugs, The Point Lippincott Williams & Wilkins
- Zeind C. S., Carvahlo M. G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
- Harvey R., Clark M. A., Finkel R., Rey, J. A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
- Tripathi K. D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers

(P) Ltd, New Delhi, 2019.

9. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
10. Craig C.R., Stitzel, R.E., Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
11. Ghosh MN. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
12. Kulkarni SK. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
13. Satoskar R.S., Bhandarkar S.D., Tripathi, R.K., Rege N.N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
14. Kasture, S.B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.

BP504T

PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

45 Hours

Course Objectives:

The aim of this course is to impart students the knowledge of how secondary metabolites are produced in plants, how to isolate them, identify them, and produce them on an industrial scale. The course will also impart in-depth knowledge of various chemical classes of phytoconstituents and their biosources and therapeutic applications.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Understand the biosynthetic pathways involved in production of secondary metabolites in plants.
2. Evaluate the physical and chemical properties of various chemical classes of secondary metabolites and appraise the therapeutic applications of crude drugs containing these
3. Evaluate the modern techniques of extraction, isolation and identification of phytoconstituents.
4. Apply the advances in extraction and isolation of phytoconstituents and design protocols for industrial scale application.

Mapping CO-PO:

BP504T <i>Course Outcomes</i>	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	2	2	1	1	1	2	1	3	3
CO2	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	3	3	2	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT -I- Metabolic pathways in higher plants and their determination.	7
1.1	Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathway and Amino acid pathways.	4
1.2	Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	3

Syllabus B.Pharm (PCI)



2	UNIT-II-General introduction, composition, chemistry & chemical classes, general methods of extraction & analysis, biosources, therapeutic uses and commercial applications of following secondary metabolites.	14
2.1	Alkaloids: Vinca, Rauwolfia, Belladonna, Opium, Cinchona	2
2.2	Phenylpropanoids and Flavonoids: Lignans-Podophyllum, Tea, Ruta.	2
2.3	Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis.	2
2.4	Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander.	2
2.5	Tannins: Catechu, Pterocarpus, Galls	1
2.6	Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony.	2
2.7	Glycosides: Senna, Aloes, Cascara, Rhubarb, Bitter Almond, Mustard	1
2.8	Iridoids-Gentian, Other terpenoids -Diterpenes: Taxus, Sesquiterpenes: Artemisia, Tetraterpenes-carotenoids- Carotene, Lutein & Naphthaquinones: Plumbago, Henna	2
3	UNIT-III	6
	Isolation, identification, and analysis of phytoconstituents 1. Terpenoids: Menthol, Citral, Artemisinin. 2. Glycosides: Glycyrrhetic acid and Rutin. 3. Alkaloids: Atropine, Quinine, reserpine, Caffeine. 4. Resins: Podophyllotoxin, curcumin.	
4	UNIT-IV	6
	Industrial production, estimation, and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine.	
5	UNIT-V-Basics of Phytochemistry	10
	Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

- Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
- Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
- Wallis T.E, Textbook of Pharmacognosy, 5th edition, J & A Churchill Ltd, London, 2005.
- Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi, 2018 reprint
- Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007.
- Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996.
- Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007.
- Kokate C.K., Purohit A.P., Gokhale S.B, Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
- Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, PharmaMed Press, A unit of BSP books Pvt.Ltd, Hyderabad, 2011.
- Khandelwal K.R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.
- Vasudevan T.N. Laddha K.S, Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
- Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt.Ltd, New Delhi, 2010.
- Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and

Wilkins Publication, 2005.

14. Pharmacognosy & Pharmacobiotechnology. Eds. Bobbers JE, Speedie MK, and Tyler VE, Williams and Wilkins, 1996.
15. Vyas SP and Dixit VK, Text Book of Biotechnology, 1st edition, CBS Publishers, 2012.
16. Dubey RC, A Textbook of Biotechnology, 5th edition, S Chand Publishers, 2014.
17. Appel L, The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition, Micelle Press, 1994.
18. Panda H, Herbal Cosmetics, 3rd revised edition, Asia Pacific Business Press, 2015.
19. R. Endress, Plant cell Biotechnology, 1st edition, Springer-Verlag Berlin Heidelberg, 1994.

BP505T

PHARMACEUTICAL JURISPRUDENCE (Theory)

45 hours

Course Objectives:

This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Course Outcomes:

Upon completion of the course, the students shall have knowledge of:

1. Recall different pharmaceutical legislations and their implications in the development, manufacturing, pricing, sale and marketing of pharmaceuticals.
2. Know the administrative authorities and agencies governing the pharmaceutical education in India and Code of ethics for pharmaceutical practice.
3. Know the regulations outlined in the Right to Information Act and Medical Termination of Pregnancy Act.
4. Know the regulations outlined in the Right to Information Act and Medical Termination of Pregnancy Act.
5. Understand the CPSCEA guidelines for Prevention of Cruelty to Animals Act.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP505T CO1	3	1	1	1	1	3	3	2	3	2	3
BP505T CO2	3	1	1	1	1	3	3	2	3	2	3
BP505T CO3	3	1	1	1	1	2	3	1	3	3	3
BP505T CO4	3	1	1	1	1	2	3	1	3	2	3
BP505T CO5	3	1	1	1	1	3	3	1	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I-Drugs and Cosmetics Act, 1940 and its rules 1945	10
1.1	Objectives, Definitions, Legal definition of schedule to the act and rules.	3
1.2	Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties.	2
1.3	Manufacture of drugs – Prohibition of manufacture and sale of certain drugs. Regulations pertaining to manufacture, Sale, Labelling and Packaging of Allopathic, Ayurvedic and Homeopathic drugs	2

Syllabus B.Pharm (PCI)



1.4	Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repackaging license.	3
2	UNIT-II-Drugs and Cosmetics Act, 1940 and its rules 1945.	10
2.1	Detailed study of Schedule G, H, M, N, P, T, U, V, X, Y, Part XII B, Schedule F & DMR (OA).	4
2.2	Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties.	1
2.3	Labeling & Packing of drugs - General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colours. Offences and penalties.	2
2.4	Administration of the act and rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors.	3
3	UNIT-III	10
3.1	Pharmacy Act – 1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties.	3
3.2	Medicinal and Toilet Preparation Act – 1955: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.	3
3.3	Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.	4
4	UNIT-IV	08
4.1	Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.	2
4.2	Prevention of Cruelty to Animals Act- 1960: Objectives, Definitions, Institutional Animal Ethics Committee, Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties.	3
4.3	National Pharmaceutical Pricing Authority: Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM).	3
5	UNIT-V	07
5.1	Pharmaceutical Legislations – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee.	1
5.2	Code of Pharmaceutical ethics Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath.	1
5.3	Medical Termination of Pregnancy Act	1
5.4	Right to information Act	1

5.5	Introduction to Intellectual Property Rights (IPR)	3
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Suresh B, A textbook of Forensic Pharmacy, 1st edition, Birla Publications Pvt Ltd, 2010.
2. Mithal BM, Textbook of Forensic Pharmacy, 10th edition, Vallabh Prakashan, 1999.
3. Mehra ML, Handbook of drug law, 9th edition, Universal Book Agency, 1997.
4. Jain NK, A textbook of Forensic Pharmacy, Vallabh Prakashan, 2017.
5. Drugs and Cosmetics Act 1940 and Rules 1945 by Govt. of India Publications.
6. Medicinal and Toilettries Preparations Act 1955 by Govt. of India Publications.
7. Narcotic Drugs and Psychotropic Substances Act by Govt. of India Publications.
8. Drugs and Magic Remedies Act 1954 by Govt. of India Publications.
9. Bare Act of the said laws published by Government of India.

BP506P

INDUSTRIAL PHARMACY (Practical)

Course Objectives:

This course is designed to impart the student skills to understand and apply the preformulation and formulation principles and techniques of solid, parenteral, ophthalmic, and cosmetic formulations. The course also aims at providing the students knowledge of testing of vehicles, packaging material and test for sterility.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. Gain and apply knowledge on analytical techniques for determination of physicochemical characteristics of active pharmaceutical ingredients.
2. Understand formulation and quality control aspects of solid orals, parenteral and ophthalmic and cosmetic products.
3. Explain the steps involved in tablet coating.
4. Implement quality control testing of tablets, capsules, water for injection, glass containers and rubber closures as per pharmacopeial specifications.

CO-PO mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP506P CO1	3	2	2	2	1	1	3	1	1	1	3
BP506P CO2	3	2	3	1	1	1	3	1	1	1	3
BP506P CO3	3	1	1	1	1	1	2	1	1	2	3
BP506P CO4	3	2	3	1	1	1	3	1	1	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Preformulation studies on paracetamol/aspirin/or any other drug.
2. Preparation and evaluation of Paracetamol tablets.
3. Preparation and evaluation of Aspirin tablets.

4. Coating of tablets-film coating of tablets/granules.(Demonstration)
5. Preparation and evaluation of Tetracycline capsules/Ampicillin trihydrate capsules
6. Preparation of Calcium Gluconate injection.
7. Preparation of Ascorbic Acid injection.
8. Quality control test of (as per IP) marketed tablets and capsules.
9. Preparation of Eye drops/and Eye ointments.
10. Preparation of Creams (cold/ vanishing cream).
11. Evaluation of Glass containers and rubbers (as per IP).
12. Evaluation of water for injection as per IP

Recommended Books:(Latest Editions to be adopted):

1. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
2. Liberman H.A, Lachman L, Pharmaceutical dosage forms. Parenteral Medications, volume 1, 2,3/edited by Avis K, Herbert A. Lieberman H. A. and Lachman L, Martin, M., 3rd edition, Marcel Dekker Inc. New York. 1993.
3. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 4rd Edition. Marcel Dekker, 2002.
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
6. Lachman, L, Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, 1st edition, Lea & Febiger, Philadelphia, 1986
7. Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.
8. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Wilkins, USA, 2014.
9. Drug stability-Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

BP507P

PHARMACOLOGY-II(Practical)

Course Objectives:

This course aims to provide a fundamental understanding of the isolation of organs and tissues from laboratory animals. It also covers preclinical models related to pharmacological activities such as anti-inflammatory, diuretic, and analgesic effects through simulated experiments. Additionally, the course also explores the concepts of drug-receptor interactions and the mechanisms of drug actions, employing various bioassay techniques like the three-point method, interpolation method, and more.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments.
2. Demonstrate the various receptor actions using isolated tissue preparation.
3. Understand the pre-clinical drug screening models of inflammation, diuresis and analgesia.

Mapping CO-PO:

BP507P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drug on isolated frog heart.
3. Effect of drug on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DR Co-facetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DR Co-facetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three-point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four-point bioassay.
11. Determination of PA_2 value of prazosin using rat aortic smooth muscle (by Schild's plot method).
12. Determination of PD_2 value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw edema model.
15. Analgesic activity of drugs using central and peripheral methods.

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments using softwares and videos.

Recommended Books (Latest Edition to be adopted):

1. Rang H.P., Dale M.M., Ritter J.M., Flower R. J., Rang and Dale's Pharmacology, 9th edition, Churchill Livingstone Elsevier, 2019.
2. Ritter J.M., Flower R.J., Henderson G., Loke Y., MacEwan D., Rang H., Rang and Dale's
3. Pharmacology, 9th edition, Elsevier Health, London 2019.
4. Katzung B.G., Masters S.B., Trevor A.J., Basic and Clinical Pharmacology, 14th edition, Tata McGraw-Hill Education, Pvt. Ltd, 2017
5. Brunton, L.L., Hilal-Dandan R., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
6. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R. W., Applied Therapeutics, The Clinical Use of Drugs, The Point Lippincott Williams & Wilkins
7. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
8. Harvey R., Clark M.A., Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolters Kluwer, 2011.
9. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
10. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.

11. Craig C.R., Stitzel, R.E., Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
12. Ghosh M.N. Fundamental of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
13. Kulkarni S.K. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
14. Satoskar R.S., Bhandarkar S.D., Tripathi, R.K., Rege N.N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
15. Kasture, S. B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.

BP508P

PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

Course Objectives:

The course is designed to impart basic skills of crude drug identification, extraction, isolation and evaluation by techniques including chromatography.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Evaluate organized crude drugs by microscopic techniques.
2. Design and execute extraction and isolation protocols for phytoconstituents.
3. Evaluate crude drugs by chromatographic techniques
4. Analyze unorganized crude drugs by chemical tests

Mapping CO-PO:

BP508P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander.

2. Exercise involving isolation & detection of active principles. Caffeine - from tea dust.

Diosgenin from Dioscorea

Atropine from Belladonna

Sennosides from Senna

3. Separation of sugars by Paper chromatography.

4. TLC of herbal extract.

5. Distillation of volatile oils and detection of phytoconstituents by TLC.

6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh.

Recommended Books: (Latest Edition to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.

Syllabus B.Pharm (PCI)



2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J&A Churchill Ltd, London, 2005.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi. 2018 reprint.
5. Kokate C.K., Purohit A.P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A. P., Gokhale S.B, Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, Pharma Med Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
10. Vasudevan T.N. and Laddha K.S, Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
11. Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.
12. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
13. Pharmacognosy & Pharmacobiotechnology. Eds. Bobbers JE, Speedie MK, and Tyler VE, Williams and Wilkins, 1996.
14. Vyas SP and Dixit VK, Textbook of Biotechnology, 1st edition, 2012, CBS Publishers.
15. Dubey RC, A Textbook of Biotechnology, 5th edition, S Chand Publishers, 2014.
16. Appel L, The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition, Micelle Press, 1994.
17. Panda H, Herbal Cosmetics, 3rd revised edition, Asia Pacific Business Press, 2015
18. R Endress, Plant cell Biotechnology, 1st edition, Springer-Verlag Berlin Heidelberg, 1994.

SEMESTER VIBP601T

MEDICINAL CHEMISTRY – III (Theory)

45 Hours

Course Objectives:

This course is designed to impart fundamental knowledge on the structure, chemistry, and therapeutic value of drugs. Modern techniques of rational drug design like quantitative structure activity relationship (QSAR), prodrug concept, combinatorial chemistry and computer aided drug design (CADD) are part of the scope of the course. The course also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. **Understand** the fundamental chemical principles underlying the biological activity of drugs and **analyze** how specific chemical properties contribute to or affect their biological activity with the help of structure-

activity relationships (SAR) analysis.

2. **Become proficient** in the fundamental concepts of drug metabolism, potential adverse effects, and therapeutic applications. **Apply** this knowledge to current medication administration, and **analyze** the intricate drug metabolism pathways, potential adverse effects, and the overall therapeutic benefits in specific medical situations.
3. **Understand and grasp** the significance of drug design, prodrug approach and various methodologies employed in the process of drug design. **Understand and apply** the concepts and principles of QSAR studies and analyses. **Understand and apply** the concepts of pharmacophore modeling and docking techniques in drug design and discovery.
4. **Apply** the concepts of combinatorial chemistry, including the principles and practical applications of both solid phase and solution phase synthesis techniques.
5. **Demonstrate proficiency** in outlining the chemical synthesis of drugs from the specified class, showcasing their ability to apply theoretical knowledge to practical synthesis techniques.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP601T CO1	2	1	2	-	-	-	-	-	1	-	2
BP601T CO2	2	1	3	-	-	1	-	1	-	-	1
BP601T CO3	2	2	3	3	2	1	-	1	-	-	1
BP601T CO4	2	2	3	2	2	1	1	-	-	-	2
BP601T CO5	2	2	2	1	-	1	1	1	1	-	1

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*).	
1	UNIT-I	12

	Antibiotics Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. (a) β-Lactam antibiotics: Penicillin, Cephalosporins, β -Lactamase inhibitors, Monobactams, Carbapenams, Imipenem. (b) Aminoglycosides: Streptomycin, Neomycin, Kanamycin. (c) Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline. (d) Macrolide: Erythromycin, Clarithromycin, Azithromycin. (e) Miscellaneous: Chloramphenicol*, Clindamycin.	
2	UNIT-II	08
	Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. Antimalarials: Etiology of malaria. Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil. Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovaquone.	
3	UNIT-III	10
3.1	Anti-tubercular Agents: (a) Synthetic anti-tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Paraaminosalicylic acid.* (b) Anti-tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine, Streptomycin, Capreomycin sulphate.	3
3.2	Urinary tract anti-infective agents: (a) Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin. (b) Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.	3
3.3	Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Ganciclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirdine, Efavirenz, Ribavirin, Saquinavir, Indinavir, Ritonavir.	4
4	UNIT-IV	08
4.1	Antifungal agents: (a) Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin. (b) Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.	2
4.2	Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine isethionate, Atovaquone, Eflornithine.	1
4.3	Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantel, Ivermectin	1



4.4	Sulfonamides and Sulfones: Historical development, chemistry, classification, and SAR of Sulfonamides: Sulfamethizole, Sulfisoxazole, Sulfamethazine, Sulfacetamide*, Sulpha pyridine, Sulfamethoxazole*, Sulfadiazine, Mefenideacetate, Sulfasalazine. Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole Sulfones: Dapsone*.	4
5	UNIT-V	07
5.1	Introduction to Drug Design Various approaches used in drug design. Prodrugs: Basic concepts and application of prodrugs design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques	5
5.2	Combinatorial Chemistry: Concept and applications of Combinatorial chemistry: Solid phase and solution phase synthesis.	2
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Beale J.M., Block J.H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T.L., Williams D.A., Roche V.F., Zito, S.W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001.
3. Abraham D. J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003.
4. Smith H.J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005.
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
6. Robert Buckingham, Martindale: The Extra Pharmacopoeia, 40th edition, Pharmaceutical Press, 2020.
7. Finar I.L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicer D., The Organic Chemistry of Drug Synthesis, Vol. 1-7, Wiley-Blackwell, 2007
9. Indian Pharmacopoeia.
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989.

BP602T

PHARMACOLOGY-III (Theory)

45 Hours

Course Objectives:

This course is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs used for respiratory and gastrointestinal diseases, infectious diseases, as part of immuno-pharmacology with emphasis on the principles of toxicology and Chronopharmacology.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases.
2. Comprehend the principles of toxicology and treatment of various poisonings.

3. Appreciate the correlation of pharmacology with related medical sciences.

Mapping CO-PO:

BP602T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	3	3	2	3	3	2	3		3
CO2	3	2	3	3	2	3	3	2	3		3
CO3	3	2	3	3	2	3	3	2	3		3
CO4	3	2	3	3	2	3	3	2	3		3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
1.1	Pharmacology of drugs acting on Respiratory system a. Anti-asthmatic drugs. b. Drugs used in the management of COPD. c. Expectorants and antitussives. d. Nasal decongestants. e. Respiratory stimulants.	5
1.2	Pharmacology of drugs acting on the Gastrointestinal Tract a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants. d. Digestants and carminatives. e. Emetics and anti-emetics.	5
2	UNIT-II	10
	Chemotherapy	
	a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics - Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracyclines and aminoglycosides, Linezolid, fusidic acid, Clindamycin.	
3	UNIT-III	10
	Chemotherapy a. Antitubercular agents. b. Antileprotic agents. c. Antifungal agents. d. Antiviral drugs. e. Anthelmintics. f. Antimalarial drugs. g. Antiamoebic agents.	
4	UNIT-IV	08

4.1	Chemotherapy a. Urinarytractinfections andsexuallytransmitteddiseases. b. Chemotherapyof malignancy.	3
4.2	Immunopharmacology a. Immunostimulants. b. Immunosuppressant. c. Proteindrugs, monoclonalantibodies. d. Antigen, biosimilars.	5
5	UNIT-V	07
5.1	Principlesoftoxicology a. Definitionandbasicknowledgeofacute, subacuteandchronictoxicity. b. Definition and basic knowledge of genotoxicity, hepatotoxicity, nephrotoxicity, carcinogenicity, teratogenicityandmutagenicity. c. Generalprinciplesoftreatmentofpoisoning. d. Clinical symptoms and management of barbiturates, morphine, organophosphoruscompoundandlead, mercuryandarsenicpoisoning.	6
5.2	Chronopharmacology a. Definitionofrhythmandcycles. b. Biologicalclockandtheirsignificanceladingtochronotherapy.	1
	TOTAL	45

ReferenceBooks(LatestEditionstobeadopted):

1. Rang H.P., Dale M.M., Ritter J.M., Flower R.J., Rang and Dale's Pharmacology, 9th edition, Churchill Livingstone Elsevier, 2019.
2. Ritter J. M., Flower R.J., Henderson G, Loke Y, MacEwan D, Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
3. Katzung B.G., Masters S.B., Trevor A.J., Basic and Clinical Pharmacology, 14th edition, Tata McGraw-Hill Education, Pvt. Ltd, 2017
4. Brunton, L.L., Hilal-Dandan R, Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
5. Marry Anne K.K., Lloyd Yee Y., Brian K.A., Robbin L.C., Joseph G.B., Wayne A.K., Bradley R. W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
6. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
7. Harvey R, Clark MA, Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
8. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
9. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
10. Craig C.R., Stitzel, R.E, Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
11. Ghosh MN. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
12. Kulkarni SK. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
13. Satoskar R.S. Bhandarkar S.D., Tripathi, R.K., Rege N. N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
14. Kasture, S.B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.

15. Udupa Nand Gupta PD, Concepts in Chronopharmacology, 1st edition, Shyam Prakashan, 2009.

BP603T

HERBAL DRUG TECHNOLOGY (Theory)

45 Hours

Course Objectives:

This course gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The course also emphasizes Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs.

Course Outcomes:

Upon completion of this course the students should be able to:

1. Understand significance of sourcing and cultivation in ascertaining quality of herbs as raw material in herbal and ASU&H products
2. Extrapolate application of herbs as nutraceuticals, excipients and cosmetics
3. Develop conventional and novel dosage herbal formulations and assess their interactions with food and other drugs
4. Apply prevalent regulatory provisions in developing herbal products and securing intellectual property rights
5. Apply GMP in design of herbal industry and infrastructure

Mapping CO-PO:

BP603T Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	1	3	3	2	3					3
CO2	3	3	3	2	2						3
CO3	3	3	3	3	2						3
CO4	3	2	3	2	2						3
CO5	3	3	3	3	3						3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	11
1.1	Herbs as raw materials Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials, Processing of herbal raw material.	3
1.2	Biodynamic Agriculture Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.	3
1.3	Indian Systems of Medicine	5
	Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Gjutika, Churna, Lehya and Bhasma.	
2	UNIT-II	07

Syllabus B.Pharm (PCI)



2.1	Neutraceuticals General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastrointestinal diseases.	2
2.2	Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina.	2
2.3	Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.	3
3	UNIT-III	10
3.1	Herbal Cosmetics Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums, colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.	4
3.2	Herbal excipients: Herbal Excipients—Significance of substances of natural origin as excipients—colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.	3
3.3	Herbal formulations: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.	3
4	UNIT-IV	10
4.1	Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs. Stability testing of herbal drugs.	2
4.2	Patenting and Regulatory requirements of natural products: 1. Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy 2. Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.	5
4.3	Regulatory Issues- Regulations in India (ASUDTAB, ASUDCC), Regulation of manufacture of ASU drugs- Schedule Z of Drugs & Cosmetics Act for ASU drugs	3
5	UNIT-V	07
5.1	General Introduction to Herbal Industry Herbal drugs industry: Presents scope and future prospects. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India.	3
5.2	Schedule T—Good Manufacturing Practice of Indian system of medicine Components of GMP (Schedule-T) and its objectives. Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and records.	4
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J& A Churchill Ltd, London, 2005.

4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi, 2018 reprint.
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D., Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi, 1996
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A. P., Gokhale S.B., Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M. A. and Nayak S. G. K., Anatomy of Crude Drugs, 12th edition, Pharma Med Press, A unit of BSP Books Pvt. Ltd, Hyderabad, 2011.
10. Khandelwal K. R. and Vrinda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.
11. Vasudevan T. N. Laddha K. S., Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
12. Shah B. A., Seth A., Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.
13. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
14. Pharmacognosy & Pharmacobiotechnology. Eds. Bobbers J.E., Speedie M.K., and Tyler V.E., Williams and Wilkins, 1996.
15. Vyas S.P. and Dixit V.K., Textbook of Biotechnology, 1st edition, 2012, CBS Publishers
16. Dubey R.C., A Textbook of Biotechnology, 5th edition, S Chand Publishers, 2014.
17. Appel L., The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition, Micelle Press, 1994.
18. Panda H., Herbal Cosmetics, 3rd revised edition, Asia Pacific Business Press, 2015.
19. R. Endress, Plant Cell Biotechnology 1st edition, Springer-Verlag Berlin Heidelberg, 1994.
19. Pharmacopoeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
20. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, 1st edition, Business Horizons Publishers, New Delhi, India, 2012.

BP604T

BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

45 Hours

Course Objectives:

This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems.

Course Objectives:

Upon completion of the course students shall be able to:

1. To introduce the routes of administration, sampling rates, definitions of Absorption, distribution, Metabolism and excretion of drugs.
2. Learn the factors that affect the Absorption, distribution, Metabolism and excretion of drugs and concept of compartmental modelling.
3. Learn the Mathematical equations that describe the plasma concentration versus time profiles of drugs administered through iv bolus, iv infusion and intramuscular dose.
4. Learn how to calculate different pharmacokinetic parameters from blood and urine data and calculating bioavailability/ bioequivalence.
5. Learn the concepts of non-linear pharmacokinetics behaviour

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP604T CO1	3	1	2	-	-	1	1	2	1	-	2
BP604T CO2	3	-	2	-	-	1	1	2	2	-	1
BP604T CO3	3	-	3	-	-	2	-	2	2	-	1
BP604T CO4	3	-	2	-	-	2	2	1	2	-	1
BP604T CO5	3	2	2	-	-	2	2	2	1	-	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

Unit	Details	Hours
1	UNIT-I	10
1.1	Introduction to Biopharmaceutics	1
1.2	Absorption: Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non-peroral extra-vascular routes.	5
1.3	Distribution: Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs.	4
2	UNIT-II	10
2.1	Drug Elimination: Metabolism of drugs and factors affecting metabolism, hepatic clearance, Renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non-renal routes of drug excretion of drugs.	3
2.2	Bioavailability and Bioequivalence: Definition and Objectives of bioavailability studies, absolute and relative bioavailability, measurement of bioavailability, methods of dissolution measurement, factors affecting dissolution, comparison of dissolution profiles, in-vitro drug dissolution models, in-vitro, in-vivo correlations, bioequivalence studies, methods to enhance the bioavailability of poorly soluble drugs. BCS classification.	7
3	UNIT -III- Pharmacokinetics	22
	Definition and introduction of pharmacokinetics, compartment models, Non-compartmental models, physiological models. One compartment open model. a. Intravenous Injection (Bolus) b. Intravenous infusion. c. Extra vascular administrations. Calculations of K_a , K_E , $t_{1/2}$, V_d , AUC , CL_t , CL_r , F_{abs} , F and other parameters. Methods of elimination, understanding of their significance and application (Urine Data – Rate method and Sigma Minus Method). Kinetics of Multiple dosing, steady state drug level, calculation of loading and maintenance dose and their significance in clinical setting. Two compartment open model (IV bolus).	
4	UNIT-IV	03
	Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Nonlinearity. c. Michaelis-Menten method of estimating parameters.	

Reference Books (Latest Edition to be adopted)

1. Gibaldi Milo, Biopharmaceutics and Clinical Pharmacokinetics. 4th Edition, 2005, Pharma Book Syndicate, Hyderabad.
2. Biopharmaceutics and Pharmacokinetics, Robert F Notari Eds, 1975, Marcel Dekker.
3. Applied Biopharmaceutics and Pharmacokinetics, Leon Shargel and Andrew B. C. Yu, 7th edition, 2016, McGraw Hill Education, USA.
4. Biopharmaceutics and Pharmacokinetics - A Treatise, By D. M. Brahmankar and Sunil B. Jaiswal, 2015, Vallabh Prakashan, Pitampura, Delhi.
5. Pharmacokinetics: By Milo Gibaldi Donald, R. Mercel Dekker Inc.
6. Handbook of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Rowland and Tozer's Clinical Pharmacokinetics and Pharmacodynamics - Concepts and Applications, Derendorf and Schmidt Seds., 5th edition, 2019, Walters Kluver.
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and Thomas, N. Tozer, Lea and Febiger, Philadelphia, 1995.
9. Abdou H. M., Dissolution, Bioavailability and Bioequivalence, Mack, Publishing Company, Pennsylvania 1989.
10. Biopharmaceutics and Clinical Pharmacokinetics - An introduction 4th edition Revised and expanded by Robert F Notari, Marcel Dekker Inc, New York and Basel, 1987.
11. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvania
12. Handbook of Basic Pharmacokinetics including clinical applications, Ritschel W A and Kearns G L, 7th edition, APhA, 2009,
13. Basic Pharmacokinetics, Jambhekar S S and Breen P J, 2nd edition, Pharmaceutical Press, 2012.
14. Biopharmaceutics and Pharmacokinetics, Venkateshwarlu V, Pharma Book Syndicate, 2010.
15. Drug Bioavailability - Estimation of solubility, permeability, absorption and bioavailability, van der Waterbeemd H, Lennernas H and Artursson P, 2nd completely revised edition, Wiley VCH Verlag, GmbH and Co, 2009.

BP605T

PHARMACEUTICAL BIOTECHNOLOGY (Theory)

45 Hours

Course Objectives:

This course is designed to introduce to the student the application of biotechnology in the field of genetic engineering, fermentation technology, diagnosis/prevention/cure of diseases, and for production of newer pharmaceutical drugs. The course will also introduce transgenic crops/animals and their contribution to healthcare.

Course outcomes:

Upon completion of the students shall be able to.

1. Understand the importance of rDNA technology in healthcare and drug development.
2. Importance of fermentation and immobilised cells/enzymes in production of pharmaceuticals.
3. Importance of Monoclonal antibodies in Industries.
4. Appreciate the concepts of immunology and vaccine production.

CO-PO Mapping

Course code &	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
---------------	-----	-----	-----	-----	-----	-----	-----	-----	-----	------	------

CO number											
BP605T CO1	3	3	3	3	-	3	1	3	-	1	3
BP605T CO2	3	3	3	3	-	3	1	1	-	2	3
BP605T CO3	3	2	3	3	-	3	1	1	-	1	3
BP605T CO4	3	2	3	3	-	3	1	-	-	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	08
1.1	Brief introduction to Biotechnology with reference to Pharmaceutical Sciences	1
1.2	Methods of enzyme/cell immobilization and applications.	2
1.3	Biosensors-Working and applications of biosensors in Pharmaceutical Industries.	1
1.4	Brief introduction to Protein Engineering.	2
1.5	Use of microbes in industry. Production of Enzymes-General consideration- Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.	2
2	UNIT -II-Basic principles of genetic engineering.	12
2.1	Study of cloning vectors, restriction endonucleases and DNA ligase.	2
2.2	Recombinant DNA technology. Application of genetic engineering in medicine.	2
2.3	Application of rDNA technology and genetic engineering in the products:	2
2.4	Interferon b) Vaccines-hepatitis-B c) Hormones-Insulin.	2
2.5	Brief introduction to PCR.	2
3	UNIT-III	10
	Types of immunity-humoral immunity, cellular immunity a. Structure of Immunoglobulins. b. Structure and Function of MHC. c. Hypersensitivity reactions, Immune stimulation and Immune suppressions. d. General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. e. Storage conditions and stability of official vaccines. f. Hybridoma technology-Production, Purification and Applications. g. Blood products and Plasma Substitutes.	
4	UNIT-IV	08
4.1	Immunoblotting techniques-ELISA, Western blotting, Southern blotting.	2
4.2	Genetic organization of Eukaryotes and Prokaryotes.	1
4.3	Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.	2
4.4	Introduction to Microbial biotransformation and applications.	2
4.5	Mutation.: Types of mutation/mutants.	1
5	UNIT-V	07
5.1	Fermentation methods and general requirements, study of media, equipment, sterilization methods, aeration process, stirring.	2
5.2	Large scale production fermenter design and its various controls.	1

5.3	Study of the production of Penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin.	2
5.4	Blood product collection, Processing and storage of whole volume blood, dried human plasma, plasma substitutes.	2
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: 5th edition, 2017, Taylor and Francis
2. Kubly Immunology, Punt J et al eds, 8th edition, WH Freeman, 2018.
3. J.W. Goding: Monoclonal Antibodies – Principles and Practice, 3rd edition, Academic Press, 1996.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology, 4th edition, Royal Society of Chemistry, 2000.
5. Zaborsky O, Immobilized Enzymes, 1973, CRC Press, Cleveland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (2nd Edition), 1992, Wiley Blackwell.
7. Stanbury F., P., Whitaker A., and Hall S.J., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi, 1995.

BP606T

PHARMACEUTICAL QUALITY ASSURANCE (Theory)

45 Hours

Course Objectives:

This course deals with the various aspects of quality control and quality assurance in pharmaceutical industries. It deals with important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. Understand the concepts of Quality assurance and learn the strategic planning, total Quality management and QbD and will know the ICH, ISO and NABL guidelines in a pharmaceutical industry.
2. Identify the organization and personnel responsibility and know the procedural and qualification aspects of procurement of raw materials and equipment.
3. Comprehend the responsibilities and significance of quality control and Good Laboratory practices.
4. Understand and apply the calibration and validation practices in pharmaceutical industry.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP606T CO1	3	2	1	3	2	3	3	3	2	3	3
BP606T CO2	3	2	1	2	2	3	3	2	1	2	3
BP606T CO3	3	1	1	1	2	3	3	2	3	1	3
BP606T CO4	3	2	2	2	2	3	3	3	2	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10

Syllabus B.Pharm (PCI)



1.1	Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP, Quality agreements, Site Master files	4
1.2	Total Quality Management (TQM): Definition, elements, philosophies.	2
1.3	ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines. Pharmaceutical audit.	2
1.4	QbD: Definition, overview, elements of QbD program, tools. Design of experiments (DOE) ISO 9000 & ISO 14000: Overview, Benefits, Elements, steps for registration.	1
1.5	NABL accreditation: Principles and procedure.	1
2	UNIT-II	10
2.1	Organization and personnel: Personnel responsibilities, training, hygiene and personal records. Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.	5
2.2	Equipment and raw materials: Equipment selection, purchase specifications, maintenance, Purchase specifications and maintenance of stores for raw materials. vendor selection and qualification	5
3	UNIT-III	10
3.1	Quality Control: Quality control test for raw materials, primary (Containers, closures) and secondary packaging materials. Microbiological testing.	5
3.2	Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities.	5
4	UNIT-IV	08
4.1	Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.	2
4.2	Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula. Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records. Data Integrity.	6
5	UNIT-V	07
5.1	Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation., Cleaning validation, Sterilization process validation.	6
5.2	Warehousing: Good warehousing practice, materials management.	1
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Sandy Weinberg, Good Laboratory Practice Regulations, in Drugs and The Pharmaceutical Sciences, Vol. 69. 3rd edition revised and expanded, Marcel Dekker, Inc., 2002.
3. Quality Assurance of Pharmaceuticals - A compendium of Guidelines and Related materials Vol II, 1st edition, WHO, Geneva, 1997

4. Kushik Maitra and Sedhan K. Ghosh, A Guide to Total Quality Management.
5. P.P. Sharma, How to Practice GMP's, 7th edition, Vandana Publications, Delhi, 2015.
6. Sadhan K. Ghosh., Introduction to ISO 9000 and Total Quality Management, 4th edition, Oxford Publishing House, 2007
7. The International Pharmacopoeia– Vol I, II, III, IV–General Methods of Analysis and Quality Specification for Pharmaceutical Substances, Excipients and Dosage forms.
8. A.F. Hirsch, Good Laboratory Practices, Drugs and the Pharmaceutical Sciences, 1st edition, Marcel Dekker Inc, 1989
9. ICH guidelines, ISO 9000 and 14000 guidelines.
10. Cole Graham, Pharmaceutical Production Facilities, Design and Applications, 2nd edition, CRC Press, 2019.
11. Nash Robert A., Berry Ira R., Pharmaceutical Process Validation, Drugs and The Pharmaceutical Sciences, Volume 129, International 3rd edition revised and expanded, Marcel Dekker Inc, New York, 2003.

BP607P

MEDICINAL CHEMISTRY-III (Practical)

Course Objectives: To make the learner understand

- a. Methods and precautions used for setting up single and multi step synthetic reactions.
- b. Monitoring the chemical reaction using TLC.
- c. Purification of the crude products.
- d. Quantify the purity of the synthesized compounds.
- e. Application of green chemistry principles using microwave reactions.
- f. Learn to visualize the 3D structures and their interactions with proteins / peptides using chemdraw software.
- g. Learn the calculation of physicochemical parameters using computational tools.

Course Outcomes:

Upon completion of the laboratory training the learners should be able to:

1. Remember/Understand the basic etiquettes of laboratory glassware, fire safety hazards and personal protection measures and follow good laboratory practices (GLP)
2. Analyze and determine the purity of drugs present in the API and tablets
3. Outline the synthesis of intermediate compounds and drugs of medicinal importance
4. Understand the Microwave assisted synthesis of organic compounds and their significance.
5. Evaluate the suitability of TLC as a technique for monitoring specific chemical reactions, considering its advantages and limitations in various contexts.
6. Build the chemical structures and predict the physico- chemical parameters by using Chem draw software.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP607P CO1	2	2	2	-	2	2	2	1	1	1	2
BP607P CO2	2	2	3	1	-	1	1	1	-	-	2
BP607P CO3	2	2	2	1	-	1	1	1	1	-	1
BP607P CO4	2	2	3	1	1	1	1	1	1	1	2
BP607P CO5	2	1	2	2	-	-	-	-	-	-	2
BP607P CO6	1	1	2	2	-	-	-	-	-	-	2

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong),

2(Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

I. Preparation of drugs and intermediates

Sulphanilamide
7-Hydroxy, 4-methyl
coumarin Chlorobutanol
Triphenyl
imidazole Tolbutami
deHexamine

II. Assay of

drugs Isonicotinic acid
hydrazide Chloroquine Met
ronidazole
Dapsone Chlorpheniramin
e maleate Benzylpenicillin

III. Preparation of medicinally important compounds or intermediates by Microwave irradiation technique.

IV. Drawing structures and reactions using Chemdraw®.

V. Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinski's RO 5).

Recommended Books (Latest Edition to be adopted):

1. Beale J.M., Block J.H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T.L., Williams D.A., Roche V.F., Zito, S.W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001.
3. Abraham D.J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003.
4. Smith H.J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005.
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005..
6. Robert Buckingham, Martindale: The Extra Pharmacopoeia, 40th edition, Pharmaceutical Press, 2020.
7. Finar I.L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicher D., The Organic Chemistry of Drug Synthesis, Vol. 1-7, Wiley-Blackwell, 2007
9. Indian Pharmacopoeia.
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989

BP608PPHARMAC **OLOGY-III (Practical)**

Course Objectives:

This course intends to impart basic understanding of dose calculations in pre-clinical studies and to elucidate the pharmacological effects of drugs on different organ systems. The statistical skills acquired will enable students to apply statistical methods to a range of preclinical data. Additionally, the course highlights the interconnection between pharmacology with other medical sciences.

Course Outcomes:

Upon completion of this course the students should be able to:

Syllabus B.Pharm (PCI)



1. Describedosecalculationsinpharmacologicalexperiments.
2. Comprehend the effects of drugs on different organs of the body.
3. Apply statistical methods to data for its analysis.
4. Appreciate the correlation of pharmacology with related medical sciences.

CO-PO Mapping

BP608P CourseOut comes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11
CO1	3	3	3	3	3	3	3	3	3	2	3
CO2	3	3	3	3	3	3	3	3	3	2	3
CO3	3	3	3	3	3	3	3	3	3	2	3
CO4	3	3	3	3	3	3	3	3	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Dose calculation in pharmacological experiments.
2. Anti allergic activity by mast cell stabilization assay.
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDs induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility.
5. Effect of agonist and antagonists on guinea pig ileum.
6. Estimation of serum biochemical parameters by using semiauto analyzer.
7. Effect of saline purgative on frog intestine.
8. Insulin hypoglycemic effect in rabbit.
9. Test for pyrogens (rabbit method).
10. Determination of acute oral toxicity (LD50) of a drug from a given data.
11. Determination of acute skin irritation/ corrosion of a test substance.
12. Determination of acute eye irritation/ corrosion of a test substance.
13. Calculation of pharmacokinetic parameters from a given data.
14. Biostatistics methods in experimental pharmacology (Student's t test, ANOVA).
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test).

**Experiments are demonstrated by simulated experiments/videos*

Recommended Books (Latest Edition to be adopted):

1. Rang H.P., Dale M.M., Ritter J.M., Flower R.J., Rang and Dale's Pharmacology, 9th edition, Churchill Livingstone Elsevier., 2019.
2. Ritter J.M., Flower R.J., Henderson G., Loke Y., MacEwan D., Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
3. Katzung B.G., Masters S.B., Trevor A.J., Basic and Clinical Pharmacology, 14th edition, Tata McGraw-Hill Education, Pvt. Ltd, 2017
4. Brunton, L.L., Hilal-Dandan R., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
5. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robin L.C., Joseph G. B., Wayne A. K., Bradley

- R. W., Applied Therapeutics, The Clinical Use of Drugs, 9th edition, Lippincott Williams & Wilkins, 2009.
6. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
 7. Harvey R., Clark M.A., Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
 8. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
 9. Sharma H.L., Sharma K.K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
 10. Craig C.R., Stitzel, R.E., Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
 11. Ghosh M.N. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
 12. Kulkarni S.K. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
 13. Satoskar R.S., Bhandarkar S.D., Tripathi, R.K., Rege N.N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
 14. Kasture, S.B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.
 16. Udupa Nand Gupta P.D., Concepts in Chronopharmacology, 1st edition, Shyam Prakashan, 2009.

BP609P

HERBAL DRUG TECHNOLOGY (Practical)

Course Objectives:

The course equips the student with skills to develop herbal formulations and evaluate them as per Pharmacopoeial specifications.

Course Outcomes:

Upon completion of the course, the students shall be able to:

1. Evaluate excipients and finished formulations of herbal origin, as per Pharmacopoeial specifications
2. Develop solid and liquid formulations of herbal origin, for oral and topical use.
3. Perform quantitative estimation of select phytoconstituents in herbal materials.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP609P CO1	3	3	3	3	3	3	3	3	3	3	3
BP609P CO2	3	3	3	3	3	3	3	3	3	3	3
BP609P CO3	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.

6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

Recommended Books: (Latest Edition to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J&A Churchill Ltd, London, 2005.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi. 2018 reprint.
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A.P., Gokhale S.B, Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, PharmaMed Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
10. Khandelwal K.R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.
11. Vasudevan T.N. and Laddha K.S, Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
12. Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.
13. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005.
14. Pharmacognosy & Pharmacobiotechnology. Eds. Bobbers JE, Speedie MK, and Tyler VE, Williams and Wilkins, 1996.
15. Vyas SP and Dixit VK, Textbook of Biotechnology, 1st edition, 2012, CBS Publishers.
16. Dubey RC, A Textbook of Biotechnology, 5th edition, S Chand Publications, 2014.
17. Appel L, The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition, Micelle Press, 1994.
18. Panda H, Herbal Cosmetics, 3rd revised edition, Asia Pacific Business Press, 2015.
19. R. Endress, Plant Cell Biotechnology, 1st edition, Springer-Verlag Berlin Heidelberg, 1994.
20. Pharmacopoeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
21. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, 1st edition, Business Horizons Publishers, New Delhi, India, reprint 2012.

SEMESTER VIIBP701T

INSTRUMENTAL METHODS OF ANALYSIS (Theory)

45 Hours

Course Objectives:

This course deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This course is designed to impart fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic techniques. Emphasis will be placed on theoretical and practical knowledge of modern analytical instruments that are used for drug testing.

Course Outcomes:

The students will be able to:

1. Comprehend underlying principle, instrumentation, application and limitations in instrumental techniques involving molecular absorption and emission techniques such as UV-Visible, Fluorescence, and Infra-Red spectroscopy.
2. Comprehend underlying principle, instrumentation, application and limitations in instrumental techniques involving atomic absorption and emission techniques such as atomic absorption spectroscopy, atomic emission spectroscopy, and nephelometry technique.
3. Describe and evaluate the chromatography techniques and electrophoresis techniques used for the separation, identification, and quantification of analytes.
4. Apply knowledge of spectroscopy and chromatographic techniques for qualitative and quantitative analysis and comprehend ICH guidelines for analytical method validation.

CO-PO Mapping for BP701 INSTRUMENTAL METHODS OF ANALYSIS (THEORY)											
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO1	3	1	3	3	-	3	3	2	3	1	3
CO2	3	1	2	3	-	3	3	2	3	1	3
CO3	3	2	3	3	1	3	3	2	3	1	3
CO4	3	3	3	3	1	3	3	2	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1.	UNIT-I	10
1.1	UV Visible spectroscopy: Introduction to Electromagnetic radiations and absorptions spectroscopy, Electronic transitions, chromophores, auxochromes, spectral shifts, Wavelength maxima, solvent effect on absorptions spectra, Beer and Lambert's law, derivation and deviations, Chemical derivatization techniques	3
1.2	Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors-Phototube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode, Single and double beam instruments	2
1.3	Pharmaceutical Applications- Spectrometric titrations, Single component and Multi component analysis by UVS spectroscopy (Assay as a single component sample, Corrected interference, Assay after solvent extraction, Simultaneous Equation method, Absorbance Ratio method, Difference Spectroscopy method, Derivative Spectroscopy), Calculation of wavelength maximum using Woodward Fieser rules for dienes and α, β -unsaturated ketones with alkyl substituents, and determination of pKa.	2

Syllabus B.Pharm (PCI)



1.4	Fluorimetry: Introduction to Molecular Emission Spectroscopy, Theory of fluorescence, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence and quenching of fluorescence Instrumentation - Filter fluorimeter and Spectrofluorimeter, Sources of radiation, Monochromators (Filters, gratings), Sample cells, Detectors Applications - Chemical derivatization of fluorescent compound, e.g. use of Dansyl chloride, Fluoresamine, o-phthalaldehyde & Choice of fluorimetry over UV-Vis spectroscopy (Sensitivity and Specificity), Pharmaceutical applications	3
2	UNIT-II	10
2.1	IR Spectroscopy: Introduction, requirements for I.R. absorption, vibrational and rotational transitions, dipole changes, potential energy diagrams (harmonic oscillator and anharmonic oscillator), force constants, fundamental modes of vibrations in polyatomic molecules, factors affecting vibrations Sample preparation for I.R spectroscopy - Solids (mulling, pelleting and thin film deposition, and in solution form), Liquids (Neat and in solution form), sample handling techniques (Attenuated Total Reflectance and Diffuse Reflectance) Instrumentation (FTIR) - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector Applications - Pharmaceutical applications including Identification, Polymorph analysis, structure elucidation for alkanes, alkenes, alkynes, alcohols, amines, aldehydes, ketones, carboxylic acids and esters, Nitro and cyano compounds, Benzene derivatives	4
2.2	Flame Photometry: Principle, interferences, instrumentation and pharmaceutical applications.	2
2.3	Atomic absorption spectroscopy: Principle, interferences, background correction methods, instrumentation and pharmaceutical applications.	2
2.4	Nepheloturbidometry: Principle, instrumentation and pharmaceutical applications.	2
3	UNIT-III	10

3.1	Classification of chromatographic methods on the basis of- interaction of solute to the stationary phase, chromatographic bed shape and the physical state of the mobile phase, by mechanism- Adsorption, partition, ion-exchange, size exclusion and affinity chromatography, Methodology, advantages, disadvantages and applications of various chromatographic methods. <i>Terminologies/concepts:</i> stationary phase, mobile phase, retention time, gradient and isocratic elution, normal and reverse phase chromatography, retention factor, internal standard, reference standard, working standard, tailing factor (symmetry factor), asymmetry factor, resolution, signal to noise ratio, column chromatography, preparative chromatography, Plate number, HETP, resolution, <i>Quantitative analysis</i> (Peak height, peak areas, calibration curve, internal standard, and area normalization) <i>Optimization of column performance</i> (Column efficiency and band broadening, shape of peak-Gaussian, Plate height, Number of theoretical plates, van Deemter equation, Capacity factor, Selectivity factor, Tailing factor, peak width, and Resolution) Numerical and justification-based problems related to chromatographic methods Adsorption and partition chromatography- Advantages, disadvantages and pharmaceutical applications	4
3.2	Thin-layer chromatography:- Introduction, Principle, Methodology- types of adsorbents, Developmental techniques, Visualisation techniques, R_f values and factors affecting resolution, advantages, disadvantages, pharmaceutical applications of TLC and Preparative TLC. HPTLC: Instrumentation- Applicator, photodensitometry, photodocumentation, Advantages of HPTLC over TLC and HPLC.	2
3.3	Paper chromatography: Introduction, Principle, Methodology- Developmental techniques (Ascending, Descending, Radial and Two-dimensional) and Spray reagents, advantages, disadvantages and pharmaceutical applications.	2
3.4	Electrophoresis: Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications.	2
4	UNIT-IV	8
4.1	Gas chromatography: Introduction, theory, Instrumentation- Carrier gas supply, Sample injection system including Headspace analysis, Columns (Packed, Open tubular columns, Capillary columns) and column ovens, Detectors (Thermal conductivity, Electron capture, Flame ionization), derivatization, temperature programming, advantages, limitations and pharmaceutical applications.	4

4.2	High performance liquid chromatography (HPLC): Introduction, theory, Instrumentation-Mobile phase reservoir, Dual piston reciprocating Pumps, Sample injection systems (Rheodyne injector and autosampler), Column types (analytical, guard and preparative columns) and column packing (porous, pellicular and monolithic), Detectors (Concept of solute and bulk property detector- Refractive index, UV-Vis, Photodiode array, fluorescence, Electrochemical, Evaporative Light Scattering), Differences between UPLC and HPLC, Applications, Advantages and Limitations of HPLC. Ion pair chromatography- Introduction, theory, instrumentation and pharmaceutical applications	4
5	UNIT-V	7
5.1	Ion exchange chromatography: Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications.	2
5.2	Gel chromatography: Introduction, theory, instrumentation and Pharmaceutical applications.	2
5.3	Affinity chromatography: Introduction, theory, instrumentation and applications.	2
5.4	Analytical method Validation-ICH guidelines.	1
	TOTAL	45

Reference Books (Latest Edition to be adopted):

1. Skoog, D. A., F. J. Holler and S. R. Crouch. Principles of Instrumental Analysis, 6th edition, Brooks Cole, 2006
2. Connors, K. A., A Textbook of Pharmaceutical Analysis, 3rd edition, John Wiley and Sons, Canada, 2007.
3. A. H. Beckett and J. B. Stenlake, Practical Pharmaceutical Chemistry, Part I and II, 4th edition, CBS Publishers and Distributors, India, 1997.
4. D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 9th edition, Saunders College Publishing, USA, 2013.
5. G. D. Christian, Analytical Chemistry, 6th edition, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd, 2003.
6. H. H. Willard, L. L. Merritt and J. A. Dean, Instrumental Method of Analysis, 7th edition, CBS Publishers & Distributors, New Delhi, 1988.
7. Indian Pharmacopoeia, The Indian Pharmacopoeia Commission, Ministry of Health and Family Welfare, Government of India.
8. United States Pharmacopeia
9. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.
10. D. G. Watson, Pharmaceutical Analysis – A textbook for pharmacy students and pharmaceutical chemists. 5th edition, Elsevier, 2020.
11. J. W. Robinson, E. M. S. Frame and G. M. Frame II, Undergraduate Instrumental Analysis, 7th edition, Marcel Dekker, CRC Press, Taylor & Francis group, New York, USA, 2014.
12. R. Kellnar, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry: A modern approach to analytical science, 2nd edition, Wiley-VCH, USA, 2004.
13. J. W. Munson, Pharmaceutical Analysis: Modern methods (in two parts), 1st edition, Marcel Dekker Inc., USA, 1981.
14. W. Kemp, Organic Spectroscopy, Palgrave Publishers Ltd., 3rd edition, New York, USA, 1991

15. R. M.

Silverstein, F. X. Webster and D. J. Kiemle, Spectrometric identification of organic compounds, 8th edition, John Wiley & Sons, Inc. (Indian edition), New Delhi (Reference book), 2014.

16. J. R. Dyer, Applications of Absorption Spectroscopy Of Organic Compounds, Eastern Economy Edition, Prentice-Hall of India Pvt Ltd, New Delhi, India, 2011.

17. D. L. Pavia, G. M. Lampman, G. S. Kriz and J. R. Vyvyan, Introduction to Spectroscopy, 3rd edition, Brooks/Cole Cengage Learning, Australia, 2011

18. L. R. Snyder, J. J. Kirkland, J. L. Glajch, Practical HPLC Method Development, 2nd edition, Wiley-Interscience publication, John Wiley & Sons, Inc., Canada (Reference book), 1997

19. S. Ahuja and M. W. Dong, Handbook of Pharmaceutical Analysis by HPLC, Volume 6 of Separation Science and Technology, 1st edition, Elsevier Academic Press, Indian edition (Reference book), 2005

BP702T

INDUSTRIAL PHARMACY II (Theory)

45 Hours

Course Objectives:

This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market.

Course Outcomes:

The learner should be able to:

1. Understand and apply the process of pilot plant and scale up considerations for solid orals, liquid orals and semisolids.
2. Comprehend the WHO guidelines for Technology Transfer, Transfer from R&D to production, Documentation, Commercialization, TOT agencies in India, Technology of Transfer (TOT) related documentation - confidentiality agreements, licensing, MoUs, legal issues.
3. Explain different Laws and Acts that regulate pharmaceutical industry as well as regulatory requirements for drug approval process.
4. Demonstrate quality management practices in pharmaceutical industries.
5. Know the compositions roles and responsibilities of various regulatory Indian bodies and describe the regulatory requirements for drug approval processes.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP702T CO1	3	3	1	1	1	3	3	2	3	2	3
BP702T CO2	3	2	1	2	1	2	1	2	2	2	3
BP702T CO3	3	3	1	2	2	2	3	2	3	2	3
BP702T CO4	3	3	1	2	1	1	2	2	2	1	3
BP702T CO5	3	3	1	2	2	2	2	3	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

Unit	Details	Hours
------	---------	-------

Syllabus B.Pharm (PCI)



1.	UNIT-I	10
	Pilot plant scale up techniques: General considerations-including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to Platform technology	
2	UNIT-II	10
	Technology development and transfer: WHO guidelines for Technology Transfer: Terminologies, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TTP process (API, excipients, finished products, packing materials) Documentation, Premises and equipment, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TOT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE/SIDBI; Technology of Transfer (TOT) related documentation - confidentiality agreements, licensing, MoUs, legal issues.	
3	UNIT-III	10
3.1	Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals.	2
3.2	Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research/BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.	8
4	UNIT-IV	8
	Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by design, Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP.	
5	UNIT-V	7
	Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Common Technical Document (CTD), Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs. ANDA	
	TOTAL	45

Recommended Books: (Latest Edition to be adopted):

1. https://en.wikipedia.org/wiki/Regulatory_affairs. (Regulatory Affairs from Wikipedia, the free encyclopedia, last edited July 2021)
2. <http://www.iraup.com/about.php>. (International Regulatory Affairs Updates, 2005)
3. Douglas J. Pisano, David Mantus, FDA Regulatory Affairs: A Guide for Prescription drugs, Medical Devices, and Biologics, 2nd edition, Informa Healthcare, Inc, 2008.

BP703T PHARMACY PRACTICE (Theory) 45 Hours

Course Objectives:

The course introduces several aspects of Hospital Pharmacy like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. The course also introduces different aspects of community pharmacy like dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Course Outcomes:

Upon completion of the course, the students shall be able to

1. Recall the organizational structure of hospitals, hospital pharmacy, and community pharmacy and their functioning.
2. Recognize various drug distribution system in the hospital, develop the contents of hospital formulary and understand the monitoring of drug therapy of patient through medication chart review and clinical review.
3. Describe the functioning of pharmacy and therapeutic committee as well as identify and assess adverse drug reactions.
4. Understand pharmaceutical care services and carry out patient counselling in community pharmacy.
5. Describe the functions and responsibilities of hospital pharmacists and clinical pharmacist and appreciate the concept of Rational Drug Therapy.
6. Explain drug store management and inventory control as well as interpret selected laboratory results of specific disease states.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP703 CO1	3	1	1	1	1	3	3	3	3	1	3
BP703 CO2	3	1	1	3	1	3	3	3	3	1	3
BP703 CO3	3	1	1	3	1	3	3	3	3	1	3
BP703 CO4	3	1	1	2	1	3	3	3	3	1	3
BP703 CO5	3	1	1	2	3	3	3	3	3	1	3
BP703 CO6	3	1	1	3	1	3	3	3	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1.	UNIT-I	10
1.1	Hospital and its organization Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non-clinical basis, Organization Structure of a Hospital, and Medical staff involved in the hospital and their functions.	2
1.2	Hospital pharmacy and its organization Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.	2

1.3	Adversedrugreaction Classifications - Excessive pharmacological effects, secondary pharmacologicaleffects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, pharmacodynamic drug interactions. Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.	3
1.4	Community Pharmacy Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store. Role of pharmacist.	3
2	UNIT-II	10
2.1	Drug distribution system in a hospital Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling. Dispensing of drugs to ambulatory patients and dispensing of controlled drugs.	2
2.2	Hospital formulary Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.	2
2.3	Therapeutic drug monitoring Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. Role of pharmacist.	2
2.4	Medication adherence Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.	1
2.5	Patient medication history interview Need for the patient medication history interview, medication interview forms.	1
2.6	Community pharmacy management Financial, materials, staff, and infrastructure requirements.	2
3	UNIT-III	10
3.1	Pharmacy and therapeutic committee Organization, functions, Policies of the pharmacy and therapeutic committee including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.	2
3.2	Drug information services Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.	1
3.3	Patient counselling Definition of patient counselling, factors affecting counselling, steps involved in patient counselling, and special cases. Role of pharmacist.	2
3.4	Education and training program in the hospital Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.	3

Syllabus B.Pharm (PCI)



3.5	Prescribed medication order and communications skills Prescribed medication order- interpretation and legal requirements, and Communications skills- communication with prescribers and patients.	2
4	UNIT-IV	8
4.1	Budget preparation and implementation Budget preparation and implementation.	2
4.2	Clinical Pharmacy Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring-medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and pharmaceutical care.	5
4.3	Over the counter (OTC) sales Introduction and sale of over the counter, and Rational use of common over the counter medications.	1
5	UNIT-V	7
5.1	Drug store management and inventory control Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure.	3
5.2	Investigational use of drugs Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.	2
5.3	Interpretation of Clinical Laboratory Tests Blood chemistry, haematology, and urinalysis.	2
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

1. Merchant S.H. and Dr. J.S. Quadry. A text book of hospital pharmacy, 4th edition, B.S. Shah Prakashan, 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A text book of Clinical Pharmacy Practice- essential concepts and skills, 1st edition, Chennai: Orient Longman Private Limited, 2004.
3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea & Febiger, 1986.
4. Tipnis and Bajaj. Hospital Pharmacy, 1st ed., Career Publications, 2008.
5. Scott L.T. Basic skills in interpreting laboratory data, 4th edition, American Society of Health System Pharmacists Inc, 2009.
6. Parmar N.S. Health Education and Community Pharmacy, 18th edition, CBS Publishers & Distributors; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356.
2. Journal of pharmacy practice. ISSN : 0974-8326.
3. American journal of health system pharmacy. ISSN: 1535-2900 (online).
4. Pharmacy times (Monthly magazine).

Course Objectives:

This course is designed to impart basic knowledge on the principles and methods for development of novel drug delivery systems.

Course Outcomes:

Upon completion of the course students shall be able to:

1. Know the basic concepts of novel drug delivery systems.
2. Classify polymers and their applications in novel drug delivery systems.
3. Explain the design of novel drug delivery systems for oral, transdermal, ocular, transmucosal, nasal, pulmonary, and parenteral route.
4. Describe the multiparticulate systems and implantable delivery systems.
5. Illustrate the classification, components & design, methods of preparation, characterization and applications of liposomes, niosomes, nanoparticles (polymeric and lipid), monoclonal antibodies and their applications.
6. Summarize the targeting systems for brain, colon, lymphatics and tumors.

CO-PO mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP704 CO1	3	1	2	1	1	1	2	1	3	2	3
BP704 CO2	3	1	3	1	1	1	2	1	3	3	3
BP704 CO3	3	1	3	3	1	1	2	1	3	2	3
BP704 CO4	3	1	2	3	1	1	2	1	3	2	3
BP704 CO5	3	1	2	2	1	1	2	1	3	2	3
BP704 CO6	3	1	2	2	1	1	2	1	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
1.1	Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Oral systems- Matrix & reservoir systems. Approaches to design of controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations. Evaluation of the systems.	7
1.2	Polymers: Introduction, classification, properties, advantages and application of polymer in formulation of controlled release drug delivery systems.	3
2	UNIT-II	10
2.1	Microencapsulation: Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation (phase separation coacervation (various techniques), Wurster process, spray drying and related processes, interfacial polymerization, multiple centrifugal process, pan coating, solvent evaporation; extrusion & spheronization), applications	4
2.2	Mucosal Drug Delivery system: Introduction, Principles of bioadhesion, mucoadhesion, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems.	3

Syllabus B.Pharm (PCI)



2.3	Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump (Basic principles of osmotic drug delivery, classification- Implantable osmotic pumps, oral osmotic pumps, applications & evaluation)	3
3	UNIT-III	10
3.1	Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.	3
3.2	Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, swelling and expandable, mucoadhesive, inflatable and gastroadhesive systems and their applications.	2
3.3	Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Advantages and limitations; Nasal drug delivery- absorption pathways of intranasally administered drugs, permeation enhancers, intranasal formulations, nose-to-brain delivery Pulmonary delivery- Weibel model of Lungs (Pulmonary tree), aerosol deposition mechanisms and pattern in lungs, concept of mass median aerodynamic diameter (MMAD) and Fine particle fraction (FPF) Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.	5
4	UNIT-IV	8
	Nanotechnology and its Concepts: Concepts and approaches for targeted drug delivery systems, advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles (polymeric and lipid), monoclonal antibodies and their applications. Concept of Targeting to Brain: Blood brain barrier (BBB), transport through BBB, factors affecting drug permeation through BBB, strategies for brain drug delivery	
	Concept of Lymphatic targeting- need and approaches- Concept of Targeting to tumor – EPR effect, ligand-based active targeting with two examples	
5	UNIT-V	7
5.1	Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome- Preliminary study, ocular formulations, in situ gelling systems and ocuserts (Non-erodible and Eroderible inserts).	5
5.2	Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs).	2
	TOTAL	45

Recommended Books: (Latest Edition to be adopted):

1. Y.W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V.H.L, Controlled Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
3. Edith Mathiowitz, Encyclopedia of Controlled Delivery. Wiley Interscience Publication, 1st edition, John Wiley and Sons, Inc, New York, 1999.
4. N.K. Jain, Controlled and Novel Drug Delivery, 1st edition, CBS Publishers & Distributors, New Delhi, 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery-

Journals

1. Indian Journal of Pharmaceutical Sciences (IPA).
2. Indian Drugs (IDMA).
3. Journal of Controlled Release (Elsevier Sciences).
4. Drug Development and Industrial Pharmacy (Marcel & Dekker).
5. International Journal of Pharmaceutics (Elsevier Sciences)

BP705P

INSTRUMENTAL METHODS OF ANALYSIS (Practical)

Course Objectives:

To impart to the learner through experiential learning the knowledge to operate the instruments, understand their functioning, prepare solutions accurately, conduct analysis using appropriate instrument, calculate, report and interpret the results of analysis.

Course Outcomes:

Upon completion of the course the learners should be able to:

1. Record, calculate and interpret data obtained from UV spectrophotometry, fluorimetry, colorimetry, flame photometry and nepheloturbidometry analysis.
2. Develop and optimize mobile phase composition for qualitative analysis by TLC and interpret data obtained by TLC and paper chromatography.
3. Outline working and application of column chromatography, HPLC and GC.
4. Apply ICH guidelines to validate an analytical method by UV spectroscopy and interpret results obtained.

Mapping CO-PO:

BP705P Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	3	3	3	2	2	3
CO2	3	3	3	3	2	3	3	3	2	2	3
CO3	3	3	3	3	2	3	3	3	2	1	3
CO4	3	3	3	3	2	3	3	3	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

LIST OF EXPERIMENTS

1. Determination of absorption maxima and effect of solvent on absorption maxima of organic compounds.
2. Estimation of dextrose by colorimetry.
3. Estimation of sulfanilamide/streptomycin sulphate injection by colorimetry.
4. Simultaneous estimation of ibuprofen and paracetamol/caffeine and sodium benzoate injection by UV spectroscopy-simultaneous equation method and absorbance ratio method
5. UV spectrophotometric estimation of formulation by Difference spectroscopy: e.g., Phenylephrine HCl ophthalmic solution.
6. Assay of Trimethoprim and cotrimoxazole tablets
7. Assay of paracetamol/paracetamol tablets/Rifampicin capsules by UV-Spectrophotometry.
8. Estimation of quinine sulfate by fluorimetry.

9. Study of quenching of fluorescence.
10. Determination of sodium by flame photometry.
11. Determination of potassium by flame photometry.
12. Determination of chlorides and sulphates by nephelometry.
13. Separation of amino acids by paper chromatography.
14. Separation of sugars by thin layer chromatography.
15. Separation of plant pigments by column chromatography.
16. Demonstration experiment on HPLC.
17. Demonstration experiment on Gas Chromatography.
18. Determination of validation parameters (linearity, precision, accuracy) by UV spectroscopy: e.g., Ibuprofen, Paracetamol.

Recommended Books (Latest Editions):

1. Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970.
2. G.D. Christian, Analytical Chemistry, 6th edition, John Wiley & Sons, Singapore, reprint by Wiley India Pvt. Ltd, 2003.
3. Connors, K. A., A Textbook of Pharmaceutical Analysis, 3rd edition, John Wiley and Sons, Canada, 2007.
4. Skoog, D. A., F. J. Holler and S. R. Crouch. Principles of Instrumental Analysis, 6th edition, Brooks/Cole, 2006
5. Skoog, D.A., and D.M. West. Fundamentals of Analytical Chemistry, 7th edition, Brooks/Cole, USA, 1995.
6. Watson, D.G, Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, 4th edition, Elsevier, 2015.
7. J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.
8. Indian Pharmacopoeia, Indian Pharmacopoeia Commission, Ministry of Health and Family Welfare, India.
9. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951.
10. D.C. Garrett., Quantitative Analysis of Drugs, 3rd edition, Springer US, 1964.
11. P. D. Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd edition, CBS Publishers and Distributors Pvt. Ltd 2019

BP706PS **PRACTICE SCHOOL (180 Hours)**

Every candidate shall undergo practice school for a period of 150 hours evenly distributed throughout the semester. The student shall opt any one of the domains for practice school declared by the program committee from time to time. At the end of the practice school, every student shall submit a printed report (in triplicate) on the practice school he/she attended (not more than 25 pages). Along with the exams of semester VII, the report submitted by the student, knowledge and skills acquired by the student through practice school shall be evaluated by the subject experts at college level and grade points shall be awarded.

SEMESTER VII

BP706PS

Practice School-Pharmaceutical Analysis (150 hours)

Course objectives:

This course aims to establish a solid understanding of pharmaceutical analysis and its significance, enable effective utilization of spectroscopic techniques for analysis and interpretation, and empower students with practical skills in chromatographic techniques. Additionally, the course focuses to foster adherence to Good Laboratory Practices and maintaining high standards of Quality Control.

Course outcomes:

<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>	<i>Syllabus Unit no.</i>
BP706PS CO1	Understand the crucial role of pharmaceutical analysis in meeting regulatory standards, and develop skills to design SOPs.	1
BP706PS CO2	Perform calibration techniques to evaluate instrument usage.	2
BP706PS CO3	Design experiments, validate methods, evaluate, and synthesize data generated through spectroscopic, chromatographic techniques or other analytical techniques used for characterization or analysis of pharmaceuticals.	3
BP706PS CO4	Conduct thorough and efficient searches in scientific literature to critically evaluate sources, summarize findings and synthesize complex information into comprehensive reports.	4

CO-PO Mapping

Syllabus B.Pharm (PCI)



BP706PS
CO5

Apply statistical methods and advanced mathematical calculations to optimize the method, quantify results, and analyse data within the realm of pharmaceutical analytical processes.

CO-PO Mapping for BP706PS PRACTICE SCHOOL-PHARMACEUTICAL ANALYSIS

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO1	3	3	2	2	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

DETAILS		HOURS
Module 1	Foundations in Pharmaceutical Analysis • Introduction-Overview of pharmaceutical analysis, significance of pharmaceutical analysis in drug development and quality control • Vital role of pharmacopoeias • Standard operating procedures (SOPs) in pharmaceutical analysis • GLP in pharmaceutical analysis • Data integrity and documentation • Sample preparation	20
Module 2	Calibration of analytical instruments • Calibration of analytical instruments.	30
Module 3	Spectroscopic and chromatographic analysis Spectroscopic analysis: Basics of spectra interpretation and Qualitative/ Quantitative analysis Chromatographic analysis: • Sample injection/ sample application, separation, and data interpretation Validation and Quality control: • Validation of analytical methods • Quality control in pharmaceutical analysis • Overview of regulatory requirements in pharmaceutical analysis	50
Module 4	Literature Search Skills & Real-world Applications • Literature search strategies • Scientific database navigation • Critical evaluation of literature • Literature organisation • Reviewing and summarising findings • Hands-on case studies and/or projects: Pharmaceutical products or internally developed formulations analysis or Impurity profiling or Stability testing or Bioanalytical techniques or other characterisation and analytical techniques	50

BP706PS

Practice School-Pharmaceutics (150 hours)

Course Description:

This course is designed to provide comprehensive understanding of pharmaceutical product development and keep them updated with current pharmaceutical industrial procedures for formulation development.

Course Outcomes	Questions	Units covered
	<i>After completion of the course, the learner will be able to:</i>	
CO1	Execute in-depth literature search pertaining to pharmaceutical product development.	Unit 1 to 6
CO2	Apply the knowledge of preformulation in development of dosage form.	Unit 3
CO3	Design the process for development of the pharmaceutical product.	Unit 3,4, 5
CO4	Apply the knowledge of statistics to assess the suitability of the pharmaceutical product.	Unit 4,5
CO5	Acquire the necessary practical and ethical skills for data compilation, interpretation and report writing.	Unit 6

CO-PO Matrix:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	2	2	3	3	3	2	3
CO2	3	3	3	3	2	2	3	2	3	2	3
CO3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	1	2	3	3	3	2	3
CO5	3	3	1	3	1	3	3	3	1	1	3

Course Outline

Unit	Details	Hours
1	Review of Basics of Pharmaceutical Dosage form (anyone from Suspensions/Tablets/Parenterals/Modified Dosage forms)	20

Syllabus B.Pharm (PCI)



2	Literature search- • Introduction to steps and techniques for effective literature search. • Utilisation of various data bases and various resources for search of research articles/review articles/patents of last 5 years. • Market search for various dosage forms and strengths • Common excipients search -MSDS, IIG, GRAS database • Drug Profile -Pharmacopeial monograph/Drug Bank • Marketed generic brands/innovative product composition.	30
---	---	----

3	Preformulation work • Preformulation of selected model drug • Functionality testing of evaluation. • Evaluation of innovative product • Packaging aspects	30
4	Formulation development, optimization, and stability studies • Identification of suitable formulation process and its process parameters. • Optimization of formulation based on process/formulation components. • Investigation of stability of developed formulations.	30
5	Introduction to data analysis (standard deviation/release kinetics/ similarity/dissimilarity/ permeation data) and data representation of formulation	20
6	Data compilation, ethics (plagiarism check) and report writing	20
	Total	150

BP706PS

Practice School-Pharmaceutic Chemistry (150 hours)

Course Objectives:

Practice school is an educational innovation seeking to link industry academia relationship. The student will be able to meet the rapidly changing needs and challenges of professional workplace. They acquire knowledge and skills and also an economic relevance to the society.

Course Outcomes: After the successful completion of course, the students will be able to-

<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>
BP706PS CO1	Apply theoretical knowledge learned in classroom in practical setting.

Syllabus B.Pharm (PCI)



BP706PS CO2	Understanding the importance and applications of various subjects and their correlation with practice of Pharmacy.
BP706PS CO3	Development of skills in the handling of modern tools Acquire skills of documentation and record keeping Plan academic, career and personal interests via research experience.
BP706PS CO4	Establish a link with potential future employers.
BP706PS CO5	Understand and Analyze their personal strengths and limitations as professionals.
BP706PS CO6	Build their interpersonal skills, communication skills, leadership qualities etc to excel in their future career prospects.

CO-PO Mapping:

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP706PS CO1	2	0	1	1	0	1	1	1	0	0	1
BP706PS CO2	1	0	1	0	0	1	1	1	1	0	1
BP706PS CO3	1	1	0	2	1	0	1	1	0	0	1
BP706PS CO4	1	0	0	0	1	1	1	1	0	0	0
BP706PS CO5	1	1	1	0	2	2	1	1	1	0	0
BP706PS CO6	1	0	0	0	1	2	1	1	0	0	0

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak).

COURSE MODULES	TOPICS	DURATION (In Hours)
	1. Bioisosterism in drug design and development. a) Introduction to bioisosterism. b) Classical and Non classical bioisosteres. c) Bio-isosteric replacement of functional groups with examples. d) Case study of procaine and procainamide. 3) Applications of bioisosterism in drug design and	

Module I (Synthetic Chemistry)	development. 2.Green Chemistry - Introduction and significance of green chemistry 12 basic principles of green chemistry. - Merits & demerits of green chemistry over conventional or traditional methods. - Real world examples of drugs synthesised by green chemistry technique. - Calculation of Atom economy and reaction efficiency of compounds synthesised by both the methods. 3.Physico chemical properties of drug molecules in relation to biological activity - Experimental determination of log p by shake flask method - Optimum range of log p value and importance. - Functional groups in improving the lipophilicity of drugs. - Novel Chromatographic techniques to calculate log p value. 4.Click Chemistry: A fascinating method of connecting organic groups - Definition and significance. - Types of reactions in Click chemistry. - Recent advancements of click chemistry in - Bioconjugation - Polymer chemistry and Macromolecular Engineering - Role of click chemistry in drug delivery. 5. Synthesis and purification of any one Organic Medicinal compound by green chemistry and characterization by TLC, Melting point and IR spectroscopy.	25 Hrs
MODULE –II Development and Analysis of Polymer Drug Conjugates for Targeted Drug Delivery and applications.	- Good Lab Practices - Systematic Literature search using authentic sources - Purification of Compounds using column chromatography - Techniques used for Synthesis of Polymer drug conjugate - Introduction to GPC and lyophilization and its application in Polymer science - Characterization of PDC using spectroscopical methods such as GPC, FTIR,	25hrs

Syllabus B.Pharm (PCI)



	Viscosity and NMR - Study the standard plot of drug using UV spectrophotometry. - Study the percentage polymer drug conjugation using UV spectrophotometry. - Drug release at specific pH conditions	
MODULE III Early Phase Hit/ lead discovery using computational methods.	- Various steps in a hit and lead discovery - Multiple techniques in computation chemistry - Good practices in structure-based drug design - Generate SAR using Molecular docking.	10 hrs
MODULE-IV Estimation of metabolic stability/ liability of a compound.	- Isolation of microsomes, ultra/Ca^{+2} aggregation - Cyp content and Protein contents - Introduction to incubation - Phenotyping, correlation analysis, Human liver bank - HRMS-1 ketoconazole metabolite and prediction assignment - Genotyping - Inhibition study protocol, HPLC methods, Cyp substrates and inhibitors, drug sweetener interactions - Development of microsomal incubation conditions - Development of an HPLC assay for compound and/or metabolite - Conduct of microsomal incubation - Conduct of HPLC assay of the incubation mixture - Analysis of data	10 hrs
MODULE-V Molecular Biology and Drug Discovery	An update and application of Molecular Biology in drug discovery	10 hrs
MODULE-VI Live demonstrations in labs	Hands on Experience/ Demonstration of latest technologies available in respective laboratories. - pH calibration and Micropipette calibration - Determination of Cyp Contents - Determination of K_m and V_{max} - Conventional and MW synthesis of pNIPAM and pDEA - Lyophilization, GPC and viscometer - Column chromatography for synthesized products	25 hrs.
MODULE-VII INTRODUCTION TO	Basic principles of HPLC, $^1\text{H-NMR}$, HR-MS.	45

Syllabus B.Pharm (PCI)



ANALYTICAL TECHNIQUES		
		150Hrs

BP706PS

Practice School-Natural Product Development (150 hours)

Course Objectives:

The objective of the course is to provide hands- on training and experience in conceptualizing, designing and executing project involving herbs as starting material; across the entire value chain right from herb identification, authentication and standardization to analytical method development and formulation as conventional / NDDS dosage form

B. Pharm Final Year, Semester VII BP706PS Natural Product Development (150 hours)			
<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>	<i>Syllabus Unit no.</i>	
BP706PS CO1	Understand the project outline and identify the steps involved	1, 2, 3 & 4	

Course Outcomes (CO):



Course code & CO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1
Syllabus B.Pharm (PCI)											
BP706PS CO2		3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
BP706PS CO1	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
BP706PS CO3	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
Module 02 Details											Hours
1 BP706PS CO4	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	45
BP706PS CO3	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
BP706PS CO4	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
BP706PS CO5	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
2 BP706PS CO5	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	45
BP706PS CO6	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
BP706PS CO6	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
3 BP706PS CO7	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	45
BP706PS CO7	3	3	3	3	3	3	3	3	3	1, 2, 3 & 4	3
4											15

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

BP706PS

Practice School-Pharmacology (150 hours)

Course Objectives:

This course aims to offer students hands-on learning opportunities in the field of Pharmacology, with a focus on Pharmacology, Toxicology, and Molecular Biology-related processes. It also facilitates learning experiences related to conducting literature reviews and analyzing them to draw comparisons and contrasts with existing scientific knowledge. Additionally, students will gain an understanding of how to create scientific reports, utilizing ICT tools, illustrations, graphical data representation, and plagiarism detection software, all of which will enhance their insights into the field of Pharmacology.

B. Pharm Final Year, Semester VII		
BP706PS PRACTICE SCHOOL (PRACTICAL- 180 hours)		
BP706PS Course Outcomes	At the successful completion of the course, the learners will be able to:	Syllabus Unit no.
BP706PS CO 1	Understand the rationale behind the preclinical models for Pharmacological and Toxicological Evaluations.	Unit 1
BP706PS CO 2	Discuss the concept and the principle behind the Pharmacology, Toxicology and Molecular Biology based techniques.	Unit 2
BP706PS CO 3	Understand the research problem identified from areas of Pharmacology and Toxicology and perform a literature review for the identified research problem.	Unit 3
BP706PS CO 4	Generate a collective research project report by leveraging the insights obtained through Microsoft Excel and Microsoft Office applications (Information and Communication Technology tools) to create a research report that addresses the identified research problem.	Unit 4
BP706PS CO 5	Apply statistical analysis methods to the obtained data and illustrate the results using tables, graphs, and schematic diagrams.	Unit 5
BP706PS CO 6	Assess the group-created project report using plagiarism detection software.	Unit 6

Mapping CO-PO

BP706PS Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3

Syllabus B.Pharm (PCI)

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -



SEMESTER

VIII BP801T

BIOSTATISTICS AND RESEARCH METHODOLOGY (Theory)

45 Hours

Course Objectives:

To understand the applications of Biostatistics in Pharmacy. This subject deals with descriptive statistics, Graphs, Correlation, Regression, logistic regression, Probability theory, Sampling technique, Parametric tests, Non-Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R, MINITAB statistical software's, and analysing the statistical data using Excel.

Course Outcomes:

Upon completion of the course the students shall be able to:

1. Know the operation of MS Excel, SPSS, R and MINITAB[®], DoE (Design of Experiment).
2. Know the various statistical techniques that apply to analysis of a given data set.
3. Appreciate the use of statistical techniques in data analysis.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP801T CO1	3	3	3	3	-	-	-	1	-	-	3
BP801T CO2	3	3	3	3	-	-	-	1	-	-	3
BP801T CO3	3	3	3	3	-	-	2	1	-	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
1.1	Introduction: Statistics, Biostatistics, Frequency distribution.	2
1.2	Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples.	3
1.3	Measures of dispersion: Dispersion, Range, standard deviation - Pharmaceutical problems.	2
1.4	Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation- Pharmaceutical examples.	3
2	UNIT-II	10
2.1	Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression - Pharmaceutical examples.	3

Syllabus B.Pharm (PCI)



2.2	Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties – problems. Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples.	4
2.3	Parametric test: t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significant difference.	3
3	UNIT-III	10
3.1	Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test.	2
3.2	Introduction to Research: Need for research, Need for design of Experiments, Experimental Design Technique, plagiarism.	3
3.3	Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph.	2
3.4	Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	3
4	UNIT-IV	8
4.1	Blocking and confounding system for Two-level factorials	2
4.2	Regression modeling: Hypothesis testing in Simple and Multiple regression models.	2
4.3	Introduction to Practical components of Industrial and Clinical Trials problems: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R-Online Statistical Software's to Industrial and Clinical trial approach.	4
5	UNIT-V	7
5.1	Design and Analysis of experiment- Factorial Design: Definition, 2^2 , 2^3 design. Advantage of factorial design.	3
5.2	Response Surface methodology: Central composite design, Historical design, Optimization Techniques.	4
	TOTAL	45

Recommended Books (Latest edition to be adopted):

- Sanford Bolton, Charles Bon, Pharmaceutical statistics - Practical and clinical applications, Drugs and the Pharmaceutical Sciences, Vol. 135, 4th edition revised and expanded, Marcel Dekker, New York,
- S.C. Gupta, Fundamental of Statistics, 7th edition, Himalaya Publishing House, 2018.
- R. Pannarselvam, Design and Analysis of Experiments, 1st edition, PHI Learning India Pvt Limited, 2012.
- Douglas, and C. Montgomery, Design and Analysis of Experiments, 10th edition, John Wiley and Sons, 2019

BP802T

SOCIAL AND PREVENTIVE PHARMACY (Theory)

45 Hours

Course Objectives:

The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduces a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Course Outcomes:

After the successful completion of this course the students shall be able to:

- Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the

Syllabus B.Pharm (PCI)



ecountry and worldwide.

2. Acquire a critical way of thinking based on current health care development.

3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP802T CO1	3	3	3	3	2	3	3	2	3	3	3
BP802T CO2	3	3	1	1	2	3	3	3	3	2	3
BP802T CO3	3	3	3	1	2	3	3	3	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
1.1	Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.	
1.2	Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.	
1.3	Sociology and health: Sociocultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health.	
1.4	Hygiene and health: personal hygiene and health care; avoidable habits.	
2	UNIT-II	10
2.1	Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chickenpox, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse.	
3	UNIT-III	10
	National health programs, its objectives, functioning and outcome of the following: HIV and AIDS control programme, TB, Integrated disease surveillance programme (IDSP), National leprosy control programme, National mental health programme, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	
4	UNIT-IV	8
	National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program.	
5	UNIT-V	7
	Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	
	TOTAL	45

Recommended Books (Latest edition to be adopted):

- Prabhakara GN, Short Textbook of Preventive and Social Medicine, 2nd Edition, ISBN: 9789380704104, Jaypee Publications, 2010.
- Roy Rabindra Nath, Saha Indranil, Textbook of Preventive and Social Medicine (Mahajan and Gupta), 4th Edition, ISBN: 9789350901878, Jaypee Publications, 2013.
- Jain Vivek, Review of Preventive and Social Medicine (Including Biostatistics), 6th Edition, ISBN:

Syllabus B.Pharm (PCI)

9789351522331, Jaypee Publications, 2014.

4. Hiremath Lalita D, Hiremath Dhananjaya A, Essentials of Community Medicine—A Practical Approach, 2nd Edition, ISBN: 9789350250440, Jaypee Publications, 2012.
5. Park, Textbook of Preventive and Social Medicine, 21st Edition, ISBN-14: 9788190128285, Banaridas Bhanot Publishers, 2011.
6. Ramesh Adepu, Community Pharmacy Practice, 1st edition, Pharma Med Press, 2017



Recommended Journals:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland.

BP803ET

PHARMACEUTICAL MARKETING MANAGEMENT (Theory) – ELECTIVE **45 Hours**

Course Objectives:

The course will provide the Knowledge and Know-how of marketing management and groom students for taking up challenging roles in Sales and Product management.

Course Outcomes:

Upon completion of the course the student will be able to:

1. Understand marketing concepts and techniques and their applications in the pharmaceutical industry.
2. Summarize the importance of market research, promotional techniques and consumer analysis.
3. Outline the product life cycle and pharmaceutical marketing channels
4. Describe the importance of management in pricing management and government regulation.

Course code & CO number	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP803ET CO1	3	1	1	1	1	2	1	1	1	1	3
BP803ET CO2	3	3	3	3	2	3	3	2	3	2	3
BP803ET CO3	3	3	3	3	2	3	3	3	3	2	3
BP803ET CO4	3	1	2	1	1	2	3	1	3	2	3

Unit	Details	Hours
1	UNIT-I	10
1.1	Marketing: Definition, general concepts, and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behaviour; industrial buying behaviour.	

Syllabus B.Pharm (PCI)



1.2	Pharmaceutical market: Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.	
2	UNIT-II	10
	Product decision: Meaning, Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labelling decisions, Product management in pharmaceutical industry.	
3	UNIT-III	10
	Promotion: Meaning and methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.	
4	UNIT-IV	8
4.1	Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.	
4.2	Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.	
5	UNIT-V	7
5.1	Pricing: Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).	
5.2	Emerging concepts in marketing: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	
	TOTAL	45

Recommended Books: (Latest Edition to be adopted):

1. Philip Kotler and Kevin Lane Keller: Marketing Management, 15th Global edition, Pearson, 2015.
2. Walker, Boyd and Larreche, Marketing Strategy-Planning and Implementation, International 3rd revised edition, McGraw Hill Education, 1999.
3. Dhruv Grewal and Michael Levy: Marketing, 8th edition, McGraw Hill, 2022
4. Arun Kumar and N Menakshi, Marketing Management, 3rd edition, Vikas Publishing, India, 2016.
5. Rajan Saxena: Marketing Management, 3rd edition, Tata MC Graw-Hill Education, India, 2005.
6. Ramaswamy, U.S & Namakamari, S: Marketing Management: Global Perspective, Indian Context, 4th edition, Ombooks, 2009
7. Ravi Shanker, Service Marketing, 1st edition, Excel Books, New Delhi, 2009.
8. Subba Rao Changanti, Pharmaceutical Marketing in India, Excel books, New Delhi, 2005.

BP804ET

PHARMACEUTICAL REGULATORY SCIENCE (Theory) – ELECTIVE

45 Hours

Course Objectives:

This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Course Outcomes:

Upon completion of the course students shall be able to;

1. Appraise on different stages of drug discovery and development of pre-clinical studies, non-clinical activities, clinical studies and understand the process of generic drug development process.
2. Explain the various regulatory authorities and agencies governing the manufacturing and sale of pharmaceutical product.
3. Know the registration process of Indian drug product in overseas market (USA and European Union)

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP804ET CO1	3	3	3	3	2	3	3	2	3	3	3
BP804ET CO2	3	3	1	1	2	3	3	3	3	2	3
BP804ET CO3	3	3	3	1	2	3	3	3	3	2	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation –

Unit	Details	Hours
1	UNIT-I	12
1.1.	New Drug Discovery and development Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development, Medical Devices, Biologics, Biosimilars.	6
1.2.	Overview of Quality systems & Assurance for Drugs and Biologics, Biologics, Medical Devices.	6
2	UNIT-II	9
2.1	Regulatory Approval Process Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA) in US. Change to an approved NDA/ANDA.	6
2.2	Regulatory authorities and agencies Overview of regulatory authorities of United States, European Union, Australia, Japan, Canada (Organization structure and types of applications).	3
3	UNIT-III	10

Syllabus B.Pharm (PCI)



3.1	Regulatory Concepts	
3.2	Basic terminologies, guidance, guidelines, regulations, laws and acts, Orangebook, Federal Register, Code of Federal Regulatory, Purplebook. Registration of Indian drug product in overseas market (USA & European Union) Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research.	8
4	UNIT-IV	7
	Clinical trials Developing clinical trial protocols, Institutional Review Board/Independent Ethics committee-formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials.	
5	UNIT-V	7
	Overview of Regulation of: -Pharmaceutical & Biologic Products -Medical Devices & Diagnostics -Nutraceuticals & Dietary Supplements	
	TOTAL	45

Recommended books (Latest edition to be adopted):

1. Sachin Itkar, N.S. Vyawahare, Drug Regulatory Affairs, 4th edition, Nirali Prakashan, Educational Publishers, 2019.
2. Ira R. Berry and Robert P. Martin (Editors), The Pharmaceutical Regulatory Process, Drugs and the Pharmaceutical Sciences, Vol. 185, 2nd Edition, Informa Healthcare, Inc, 2008.
3. Richard A Guarino, New Drug Approval Process: Accelerating Global Registrations, Drugs and the Pharmaceutical Sciences, 5th edition, Vol. 190, Informa Healthcare, Inc, 2009.
4. Sandy Weinberg, Guidebook for Drug Regulatory Submissions, 1st edition, John Wiley & Sons. Inc., 2008.
5. Douglas J. Pisano, David Mantus, FDA Regulatory Affairs: A Guide for Prescription drugs, Medical Devices, and Biologics, 2nd edition, Informa Healthcare, Inc, 2008.
6. Leon Shargel and Isader Kaufer, Generic Drug Product Development, Solid Oral Dosage forms, Vol. 143, 1st edition, Marcel Dekker, New York, 2005.
7. Fay A. Rozovsky and Rodney K. Adams, Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance, 1st edition, Jossey-Bass, San Francisco, 2003.
8. John I. Gallin and Frederick P. Ognibene, Principles and Practices of Clinical Research, 3rd Edition, Academic Press, 2012.
9. Rick Ng., Drugs: From Discovery to Approval, 2nd Edition, Wiley Blackwell, 2012,

BP805ET

PHARMACOVIGILANCE (Theory) – ELECTIVE

45 Hours

Course Objectives:

This course will provide an opportunity for the student to learn about the development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance. The course will train students on establishing pharmacovigilance program in an organization, various methods that can be used to generate safety data, signal detection, skills of classifying drugs, diseases and adverse drug reactions.

Syllabus B.Pharm (PCI)



Course Outcomes:

Upon completion of the course students shall be able to;

1. Appreciate drug safety monitoring and History and development of pharmacovigilance
2. Understand the National and international scenario of pharmacovigilance and Dictionaries, coding and terminologies used in pharmacovigilance
3. Understand the mechanisms for Detection of new adverse drug reactions and their assessment, Adverse drug reaction reporting systems and communication in pharmacovigilance
4. Have knowledge of Methods to generate safety data during preclinical, clinical and post approval phases of drugs' lifecycle, Drug safety evaluation in pediatrics, geriatrics, pregnancy, and lactation.
5. Know the Pharmacovigilance Program of India (PvPI), ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning and CIOMS requirements for ADR reporting
6. Write case narratives of adverse events and their quality.

Mapping CO-PO:

BP805ET Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
1.1	Introduction to Pharmacovigilance History and development of Pharmacovigilance. Importance of safety monitoring of Medicine. WHO international drug monitoring programme. Pharmacovigilance Program of India (PvPI).	4
1.2	Introduction to adverse drug reactions Definitions and classification of ADRs. Detection and reporting. Methods in Causality assessment. Severity and seriousness assessment. Predictability and preventability assessment. Management of adverse drug reactions.	4
1.3	Basic terminologies used in pharmacovigilance Terminologies of adverse medication related events. Regulatory terminologies	2
2	UNIT-II	10
2.1	Drug and disease classification Anatomical, therapeutic, and chemical classification of drugs. International classification of diseases. Daily defined doses. International Non-proprietary Names for drugs.	3
2.2	Drug dictionaries and coding in pharmacovigilance WHO adverse reaction terminologies. MedDRA and Standardised MedDRA queries. WHO drug dictionary. Eudravigilance medicinal product dictionary.	3
2.3	Information resources in pharmacovigilance Basic drug information resources. Specialised resources for ADRs	2

Syllabus B.Pharm (PCI)



2.4	Establishing pharmacovigilance programme Establishing in a hospital. Establishment & operation of drug safety department in industry. Contract Research Organisations (CROs). Establishing a national programme.	2
3	UNIT-III	10
3.1	Vaccine safety surveillance Vaccine Pharmacovigilance. Vaccination failure. Adverse events following immunization.	3
3.2	Pharmacovigilance methods Passive surveillance – Spontaneous reports and case series. Stimulated reporting. Active surveillance – Sentinel sites, drug event monitoring and registries. Comparative observational studies – Cross sectional study, case control study and cohort study. Targeted clinical investigations.	5
3.3	Communication in pharmacovigilance Effective communication in Pharmacovigilance. Communication in Drug Safety Crisis management. Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media.	2
4	UNIT-IV	8
4.1	Statistical methods for evaluating medication safety data Safety data generation Preclinical phase. Clinical phase. Post approval phase.	3
4.2	ICH Guidelines for Pharmacovigilance Organization and objectives of ICH. Expedited reporting. Individual cases safety reports. Periodic safety update reports. Post approval expedited reporting. Pharmacovigilance planning. Good clinical practice in pharmacovigilance studies.	5
5	Unit – V	7
5.1	Pharmacogenomics of adverse drug reactions Genetics related ADR with example focusing PK parameters.	3
5.2	Drug safety evaluation in special population Paediatrics. Pregnancy and lactation. Geriatrics.	2
5.3	CIOMS CIOMS Working Groups. CIOMS Form.	1
5.4	CDSCO (India) and Pharmacovigilance D&C Act and Schedule Y. Differences in Indian and global pharmacovigilance requirements.	1
	TOTAL	45

Recommended Books (Latest edition to be adopted):

1. SK Gupta, Textbook of Pharmacovigilance, 1st edition, Jaypee Brothers Medical Publishers Pvt. Ltd, 2019.
2. Barton Cobert, Pierre Biron, Practical Drug Safety from A to Z, 1 edition, Jones and Bartlett Publishers Inc, 2017
3. Elizabeth B. Andrews, Nicholas Moore (eds), Mann's Pharmacovigilance, 3rd edition, Wiley Blackwell Publishers, 2014.
4. John Talbot, Patrick Walle, Stephens' Detection of New Adverse Drug Reactions, Wiley Blackwell Publishers.
5. Patrick Waller and Mira Harrison-Woolrych, An Introduction to Pharmacovigilance, 2nd edition, Wiley Blackwell Publishers, 2017
6. Barton Cobert, William Gregory, Jean-

Syllabus B.Pharm (PCI)

Courp Thomas, Cobert's Manual of Drug Safety and Pharmacovigilance, 3rd edition, World Scientific, 2019.



7. Brian L. Strom, Stephen E Kimmel, Sean Hennessy (Editors), Textbook of Pharmacoepidemiology, 6th edition, Wiley Blackwell Publishers, 2013.
8. G. Parthasarathi, Karin Nyfort Hansen, Milap C. Nahata, A Textbook of Clinical Pharmacy Practice- Essential Concepts and Skills, 1st edition, Universities Press, 2014.
9. National Formulary of India, Ministry of Health, Government of India, 5th edition, 2016
10. Yashpal Munjal, APITextbook of Medicine, 10th edition, Jaypee Brothers Medical Publishers (P) Ltd, 2015.
11. GPMohanta and PKManna., Textbook of Pharmacovigilance: Concept and Practice, First edition, BSP books, 2015.
12. <http://www.who.int/medicines/monitoring-evaluation/active-pharmacovigilance/>
13. <http://www.ich.org/>
14. <http://www.cioms.ch/>
15. <http://cdsco.nic.in/>
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

BP806ET

QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory) ELECTIVE 45 Hours

Course Objectives:

In this course the student will learn about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The course also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

Course Outcomes:

Upon completion of the subject the student shall be able to;

1. Know WHO guidelines for quality control of herbal drugs
2. Know Quality assurance in herbal drug industry
3. Know the regulatory approval process and their registration in Indian and international markets
4. Appreciate EU and ICH guidelines for quality control of herbal drugs

Unit	Details	Hours
1	UNIT-I	10
	Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms. WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use.	
2	UNIT-II	10
2.1	Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.	6
2.2	WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	4
3	UNIT-III	10
	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.	
4	UNIT-IV	08

Syllabus B.Pharm (PCI)



	Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration. GMP requirements and Drugs & Cosmetics Act provisions.	
5	UNIT-V	07
	Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems. Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products.	
	TOTAL	45

Recommended Books: (Latest Edition to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, 5th edition, J & A Churchill Ltd, London, 1967.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, 1st edition, CBS Publishers & Distributors, New Delhi, 2018 reprint
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi, 1996.
7. Ansari S.H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007.
8. Kokate C.K., Purohit A.P., Gokhale S.B., Practical Pharmacognosy, 13th edition, Nirali Prakashan, New Delhi, 2009.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, PharmaMed Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
10. Khandelwal K.R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, 24th edition, Nirali Prakashan, 2014.
11. Vasudevan T.N. Laddha K.S, Practical Pharmacognosy, 1st edition, New Vrinda Publishing House, Jalgaon, 1987.
12. Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.
13. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, 2005.
14. Bobbers JE, Speedie MK, and Tyler VE, Pharmacognosy & Pharmacobiotechnology, Williams and Wilkins, Baltimore, 1996.
15. Vyas SP and Dixit VK, Textbook of Biotechnology, 1st edition, CBS Publishers, 2012.
16. Dubey RC, A Textbook of Biotechnology, 5th edition, S Chand Publishing, 2014.
17. Appel L, The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition, Micelle Press, 1994.
18. Panda H, Herbal Cosmetics, 3rd revised edition, Asia Pacific Business Press, 2015.
19. R. Endress, Plant Cell Biotechnology, 1st edition, Springer-Verlag, Berlin, 1994.
20. Pharmacopoeial standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).
21. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals, 1st edition, Business Horizons Publishers, New Delhi, India, reprint 2012.
22. Agarwal, S.S., Herbal Drug Technology, 2nd edition, Universities Press, 2002.
23. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products.
24. Shinde M.V., Dhalwal K., Potdar K., Mahadik K, Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1 (2009); p.4-8.
25. WHO, Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998.
26. WHO, Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 199

27. WHO, The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edition, World Health Organization, Geneva, 1981.
28. WHO, Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
29. WHO, WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
30. WHO, Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP807ET

COMPUTER AIDED DRUG DESIGN (Theory)-ELECTIVE

45 Hours

Course Objectives:

This course is designed to provide detailed knowledge of the application of computational methods in rational drug design process and various techniques used in rational drug design process.

Course Outcomes:

Upon completion of the course, the students shall be able to understand:

1. Design and discovery of lead molecules
2. The role of drug design in drug discovery process
3. The concept of QSAR and docking
4. Various strategies to develop new drug like molecules.
5. The design of new drug molecules using molecular modelling software

Unit	Details	Hours
1	UNIT-I	10
1.1	Introduction to Drug Discovery and Development Stages of drug discovery and development.	2
1.2	Lead discovery and Analog Based Drug Design Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.	4
1.3	Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies.	4
2	UNIT-II	10
	Quantitative Structure Activity Relationship (QSAR) SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.	
3	UNIT -III- Molecular Modeling and virtual screening techniques	10
3.1	Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based screening,	6
3.2	Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. <i>De novo</i> drug design.	4
4	UNIT-IV	8
	Informatics & Methods in drug design Introduction to Bioinformatics, cheminformatics. ADME databases, c	

Syllabus B.Pharm (PCI)



	chemical, biochemical and pharmaceutical databases.	
5	UNIT-V	7
	Molecular Modeling: Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minimization determination.	
	TOTAL	45

Recommended Books (Latest Edition to be adopted)

1. Beale J.M., Block J.H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T.L., Williams D. A., Roche V.F., Zito, S.W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams, and Wilkins Publishers, 2001.
3. Abraham D.J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., 2003.
4. Smith H.J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005.
5. Robert GCK, Drug Action at the Molecular Level, 1st edition, Palgrave Macmillan UK, 1977.
6. Martin YC, Quantitative Drug Design, 2nd edition, CRC press, 2010.
7. Korolkovas A, Burckhalter JH, Essentials of Medicinal Chemistry, 2nd edition, Wiley-Blackwell, 1988.
8. Wolf ME, The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry, John Wiley & Sons, New York, 1980
9. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press, 2013.
10. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
11. Silverman R. B. The Organic Chemistry of Drug Design and Drug Action, 3rd edition, Academic Press New York, 2014.

BP808ET

CELL AND MOLECULAR BIOLOGY (Theory)-ELECTIVE

45 Hours

Course Objectives:

The course will introduce the student to cells, their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.

Course Outcomes:

Upon completion of the subject the student shall be able to;

1. Learn history of cell and molecular biology and understand basic chemical, physical and genetic foundations of cell
2. Explain about structure of biomolecules DNA, RNA and proteins and their importance in various cellular processes
3. Outline mechanisms of gene expression and its regulation
4. Learn and understand cellular process like cell cycle, cell death, cell signaling pathways
5. Assess how to carry out analysis of genome and proteome and application techniques like transgenics
6. Analysis and assess molecular basis of diseases like cancer and application of biotechnology in designing new line of treatment modalities.

Mapping CO-PO:

Syllabus B.Pharm (PCI)



BP805ET Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	2	1	-	-	-	-	-	-	3
CO2	3	1	2	1	-	-	-	-	-	-	3
CO3	3	1	3	1	-	-	-	-	-	-	3
CO4	3	1	2	1	-	-	-	1	-	-	3
CO5	3	2	3	3	1	1	2	1	3	1	3
CO6	3	2	3	3	1	1	3	1	3	1	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	10
	a) Cell and Molecular Biology: Definition, theory and basic applications. b) Cell and Molecular Biology: History and Summation. c) Theory of the Cell. Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)	
2	UNIT-II	10
	DNA and the Flow of Molecular Structure, DNA Functioning, DNA and RNA, Types of RNA, Transcription and Translation.	
3	UNIT-III	10
	Proteins: Defined and Amino Acids, Protein Structure, Regularities in Protein Pathways, Cellular Processes, Positive Control and significance of Protein Synthesis.	
4	UNIT-IV	8
	Science of Genetics, Transgenics and Genomic Analysis, Cell Cycle analysis, Mitosis and Meiosis, Cellular Activities and Checkpoints.	
5	UNIT-V	7
	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

- Hugo W.B. and Russel A.D, Pharmaceutical Microbiology, 8th Edition, Blackwell Scientific publications, Oxford, London, 2013.
- Reed G., Prescott and Dunn's, Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2004.
- Pelczar MJ, Chan ECS, Kreig NR. Microbiology, 6th Edition, Tata McGraw Hill Education Pvt. Ltd, Delhi, 1993.
- Harris M, Tindall B, and Cox, Pharmaceutical Microbiology, 1st edition, 1964, The Williams and Wilkins, Baltimore, 1964.

Syllabus B.Pharm (PCI)



5. Rose AH, Industrial Microbiology, 1st edition, Butterworths (Elsevier), Oxford, 1961.
6. Frobisher M, Hins Dill RD, Crabtree KT, Goodheart CR, Fundamentalsof Microbiology, 9th edition, Japan, 1974.
7. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
8. Peppler HJ, Microbial Technology, 2nd Edition, Academic Press (Elsevier), Massachusetts, 1979.
9. I.P., B.P., U.S.P. - latest editions.
10. Reba Kanungo, Ananthnarayan and Paniker's Textbook of Microbiology, 10th Edition, Orient-Longman, Chennai, 2017.
11. Pommerville, J.C., Alcamo's Fundamentalsof Microbiology, 3rd Edition, Jones and Bartlett, Burlington, Massachusetts, 2014.
12. Jain N.K, Pharmaceutical Microbiology, 3rd Edition, Vallabh Prakashan, Delhi, 2001.
13. Garry G.M., Bergey's Manual of Systematic Bacteriology, 2nd Edition, Springer publishing, New York, 2005.
14. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: 5th edition, 2017, Taylor and Francis
15. Kubly Immunology, Punt Jet al eds, 8th edition, WH Freeman, 2018.
16. J.W. Goding: Monoclonal Antibodies – Principles and Practice, Academic Press, 1996.
17. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology, 4th edition, Royal Society of Chemistry, 2000.
18. Zaborsky O, Immobilized Enzymes, 2nd edition, CRC Press, Cleveland, Ohio, 1973.
19. S.B. Primrose: Molecular Biotechnology, 2nd edition, Wiley Blackwell, 1992.
20. Lehninger AL, Nelson DL, Cox MM. Lehninger Principles of Biochemistry, 7th edition, Macmillan, New York, 2017.
21. Murry RK, Granner DK, Mayes PA, Rodwell VW, Harper's Biochemistry, 23rd edition, Appleton & Lange, Connecticut, 1993.
22. Berg JM, Tymoczko JL, Stryer L. Biochemistry, 9th edition, WH Freeman, New York, 2019.

BP809ET

COSMETIC SCIENCE (Theory) – ELECTIVE

45 Hours

Course Objectives: This course is designed to impart the learner with knowledge of Cosmeticology with respect to the types of formulations, evaluation, and regulatory aspects.

Course Outcomes: Upon completion of the course, the learners shall be able to:

1. Identify types of skin, skin disorders and summarize the various raw materials used in cosmetics.
2. Identify, compare, and correlate the different standards & testing products for evaluation of various cosmetic products based on their application.
3. Identify and comprehend the process involved in the large-scale production of cosmetic products based on their application.
4. Discuss the regulatory guidelines and sensorial assessment for cosmetics.

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP809ET CO1	3	2	3	-	-	1	1	2	3	3	3
BP809ET CO2	3	2	3	3	-	3	3	2	3	3	3
BP809ET CO3	3	2	3	3	-	2	2	2	3	3	3
BP809ET CO4	3	2	3	3	-	3	3	2	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Syllabus B.Pharm (PCI)



Unit	Details	Hours
1	UNIT-I	10
1.1	Classification of cosmetic and cosmeceutical products. Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs.	2
1.2	Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives, perfumes, colours, oils, fats, waxes, antioxidants and water. Classification and applications. Skin: Basic structure and function of skin. Hair: Basic structure of hair. Hair growth cycle. Oral Cavity: Common problem associated with teeth and gums.	8
2	UNIT-II	10
2.1	Principles of formulation and building blocks of skincare products: Face wash, Moisturizing cream, Cold Cream, Vanishing cream, Barrier creams and colored cosmetics (eye makeup, lipsticks, and nail lacquer) their relative skin sensory, advantages and disadvantages. Application of these products in formulation of cosmeceuticals.	5
	Principles of formulation and building blocks of Haircare products: Cleansing and Conditioning shampoo, Hair conditioners, anti-dandruff shampoo. Hair grooming preparations - Hair setting lotions & sprays; Brilliantines, Hair oils. Chemistry and formulation of Para-phenylenediamine-based hair dye. Principles of formulation and building blocks of oral care products: tooth powder, toothpaste, Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, denture cleansers, mouthwash. Shaving products (Wet, Dry & After shave), Depilatory preparations	5
3	UNIT-III	10
3.1	Sun protection, Classification of Sunscreens and SPF.	2
3.2	Role of herbs in cosmetics: Skin Care: Aloe and turmeric. Hair care: Henna and amla. Oral care: Neem and clove. Case study of Herbal products (Self Study)	6
3.3	Analytical cosmetics: BIS specification and analytical methods for shampoo, skin-cream and toothpaste.	2
4	UNIT-IV	8
	Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties, Soaps and syndet bars. Evolution and skin benefits. Irritation and sensitization reactions to cosmetics, sensitivity testing and safety aspects. Sensorial evaluation of cosmetics - concept and need, sensory perception, requirements for sensory testing, methods used, interpretation and documentation/representation.	
5	UNIT-V	7
	Oily and dry skin causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis.	

Syllabus B.Pharm (PCI)



	Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes. Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat, and body odor. Antiperspirants and Deodorants- Actives and mechanism of action.	
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

1. R.G.Harry, J.B.Wilkinson, Harry's Cosmeticology, edited by J.B. Wilkinson and R.J. Moore, 7th edition, Harlow Essex: Longman Scientific & Technical Publishers, 1994.
2. P.P.Sharma, Cosmetics – Formulations, Manufacturing and Quality Control, 5th Edition, Vandana Publications Pvt.Ltd., Delhi, 2008.
3. Nanda S, Nanda A and Khar RK, Cosmetic Technology, Birla Publications, 2011.
4. J.S.Jellinek, Formulation and function of cosmetics, 3rd edition, Wiley Interscience, New York, 1970
5. Poucher's Perfumes, Cosmetics & Soaps, 10th Ed, Editor- Hilda Butler, Kluwer Academic Publishers, Netherlands, 2000.
6. Kemp S.E., Hollowood T, Hort J., "Sensory evaluation-A practical handbook," John Wiley & Sons, 2009.
7. M.S.Balsam, E.Sagarin, S.D.Gerhon, S.J.Strianse and M.M.Rieger Cosmetics Science and Technology, Edited by M.S.Balsam, E. Sagarin, S.D.Gerhon, S. J. Strianse and M. M. Rieger, Volumes 1, 2 and 3, Wiley-Interscience, Wiley India Pvt.Ltd., 2008
8. Morten C. Meilgaard, B. Thomas Carr, Gail Vance Civile, Sensory Evaluation Techniques, 4th Edition, CRC Press
9. ISO 13299:2016 Sensory analysis — Methodology — General guidance for establishing a sensory profile (<https://www.iso.org/standard/58042.html>)
10. BIS standards for cosmetics preparations (<https://www.bis.gov.in/index.php/standards/technical-department/petroleum-coal-and-related-products/indian-standards-referred-in-government-regulations/>)

BP810ET

EXPERIMENTAL PHARMACOLOGY-ELECTIVE

45 Hours

Course Objectives:

This course is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretation of results.

Objectives:

Upon completion of the course the students shall be able to,

1. Appreciate the application of various commonly used laboratory animals.
2. Appreciate and demonstrate the various screening methods used in preclinical research
3. Appreciate and demonstrate the importance of biostatistics and research methodology
4. Design and execute research hypothesis independently

Unit	Details	Hours
1	UNIT-I	8
	Laboratory Animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and	

Syllabus B.Pharm (PCI)



	conduct of experiments on laboratory animals, Common lab animals: Description and application of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	
2	UNIT-II	13
2.1	Preclinical screening models Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's, anti-asthmatics.	6
2.2	Preclinical screening models: for CNS activity-analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, anti-Parkinsonism, Alzheimer's disease	7
3	UNIT-III	12
	Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics.	
4	UNIT-IV	12
4.1	Preclinical screening models: for CVS activity-anti-hypertensives, diuretics, antiarrhythmic, anti-dyslipidemic, anti-aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like anti-ulcer, anti-diabetic, and anti-cancer.	6
4.2	Research methodology and Biostatistics Selection of research topic, review of literature, research hypothesis and study design. Pre-clinical data analysis and interpretation using Student's 't' test and One-way ANOVA. Graphical representation of data.	6
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

1. Ghosh MN. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
2. Kulkarni SK. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
3. CPCSEA guidelines for laboratory animal facility, 2020.
4. Vogel H.G, Drug discovery and Evaluation, 3rd edition, Springer, 2007.
5. Suresh Kumar Gupta and S. K. Gupta, Drug Screening Methods, 3rd edition, Jaypee Brothers Medical Publishers, 2016.
6. PSSSundar Rao and J Richard, Introduction to Biostatistics and Research Methods, 5th edition, PHI Learning Pvt Ltd, 2012.

BP811ET

ADVANCED INSTRUMENTATION TECHNIQUES (Theory) – ELECTIVE

45 Hours

Course Objectives:

Syllabus B.Pharm (PCI)



This course deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This course is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Course Outcomes:

Upon completion of the course the students will be able to:

1. Describe the principle and working of ^1H NMR and ^{13}C -NMR spectroscopy, mass spectrometry techniques and hyphenated techniques.
2. Analyse and Interpret spectral data to predict structure of a given compound and propose mass fragmentation pathway.
3. Explain fundamentals, working principle and applications of X-ray diffraction technique and thermal methods of analysis like TG, DSC and DTA and extraction techniques.
4. Understand the concepts and quality control aspects related to radiopharmaceuticals and radioimmunoassay.
5. Describe calibration procedures for analytical instruments and compare validation parameters for analytical and bioanalytical procedures.

CO-PO Mapping for BP 811 ET ADVANCED INSTRUMENTATION TECHNIQUES (THEORY)											
CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO1	3	1	1	2	1	3	3	1	3	-	3
CO2	3	3	3	2	1	3	3	3	3	-	3
CO3	3	2	3	2	1	3	3	1	3	2	3
CO4	3	2	2	2	1	3	3	1	3	2	3
CO5	3	3	3	2	1	3	3	2	3	-	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Unit	Details	Hours
1	UNIT-I	19

Syllabus B.Pharm (PCI)



1.1	Nuclear Magnetic Resonance spectroscopy Principles of ^1H -NMR and ^{13}C -NMR, spinning nucleus, precessional motion, precessional frequency, gyromagnetic ratio, energy transitions and relaxation processes, NMR Spectra, chemical shift, factors affecting chemical shift (Electronegativity- Shielding and Deshielding, Vander Waal's deshielding, anisotropic effect), shielding and deshielding, Vander Waal's deshielding, Deuterium exchange, Chemical and magnetic equivalence, anisotropic effect (e.g. Alkanes, alkenes, alkynes, carbonyl, aromatic and cyclohexane), Solvents, Reference compounds and internal standards, coupling constant, Spin-spin coupling – Spin-spin splitting (N+1 rule (Pascal's triangle), theory of spin-spin splitting, formation of doublet, triplet and quartet due to possible spin orientations, inverted tree diagram, Coupling constants & values for alkyl, alkenyl, aromatic), relaxation, instrumentation and pharmaceutical applications Structural elucidation of simple organic molecules with molecular formula using ^1H -NMR and/or ^{13}C -NMR with or without IR spectroscopic and UV spectroscopic data	
1.2	Mass Spectrometry- Principles, Mass spectrum, relative abundance, mass to charge ratio, molecular ion, fragment ion (daughter ion), metastable ion, base peak, isotope peak, mass to charge ratio, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers- Time of flight and Quadrupole, instrumentation, pharmaceutical applications Examples of different Fragmentation pathways- Fissions (homolytic and heterolytic, α and β fission), Rearrangement (McLafferty, Retro Diel-Alders, 4 membered cyclic rearrangement), Nitrogen rule and Even electron rule	
2	UNIT-II	10
2.1	Thermal Methods of Analysis: Principles, instrumentation, factors affecting analysis and pharmaceutical applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC).	
2.2	X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X-ray Crystallography, Bragg's Law. Rotating crystal technique, single crystal diffraction, powder diffraction, instrumentation, structural elucidation and pharmaceutical applications.	
3	UNIT-III	6
3.1	Calibration and validation - as per ICH and USFDA guidelines.	
3.2	Calibration of following Instruments - Electronic balance, UV-VIS spectrophotometer, FTIR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC. Comparison of validation of analytical and bioanalytical methods by ICH and USFDA guidelines	
4	UNIT-IV	6

Syllabus B.Pharm (PCI)



4.1	Radiopharmaceuticals and Radioimmunoassay Properties of radionuclide, Radioisotope, Radioactive decay, half-life of radioactivity, specific activity, Becquerel, curie, Sievert and Gray, Relative biological effectiveness, Radionuclidic purity, Radiochemical purity, Safety aspects of radiopharmaceutical laboratory, Measurements of radioactivity- Geiger-Muller Counting, liquid Scintillation Counting Requirements of radiopharmaceuticals- Properties of radionuclides, Pharmaceutical and chemical properties, Radionuclide generator- 99mTc generator, Quality control of radiopharmaceuticals: Physical, Chemical (Radionuclidic purity, Radiochemical purity) Radioimmunoassay- Importance, various components, Principle, different methods, Limitation and Application of Radioimmunoassay	
4.2	Extraction techniques: Nernst Distribution law and partition coefficient, Distribution coefficient, Distribution Ratio, Percent extraction or extraction efficiency, Separability factor. General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	
5	UNIT-V	4
	Hyphenated techniques -Significance, interfaces and applications of LC-MS/MS, GC-MS/MS, HPTLC-MS.	
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

- Sharma, B.K., Instrumental Methods of Chemical Analysis, 24th revised and enlarged edition, Goel Publishing House, Meerut, 2005.
- Y.R. Sharma, Elementary Organic spectroscopy, Principles and Chemical Applications, 5th Edition, S. Chand Publishing, 2013.
- Beckett A.H., Stenlake J.B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970
- Connors, K.A., A Textbook of Pharmaceutical Analysis, 3rd edition, John Wiley and Sons, Canada., 2007.
- Skoog, D.A., F.J. Holler and S.R. Crouch. Principles of Instrumental Analysis, 6th edition, Brooks Cole, 2006.
- J. Mendham, R.C. Denney, J.D. Barnes, M.J.K. Thomas, B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.
- Silverstein R.M. and Webster F.X., Spectrophotometric identification of Organic Compounds, 6th edition, John Wiley and Sons, 1998.
- Finar I.L., Organic Chemistry, Vol. 1, 4th edition, Longman, 1963.
- Organic spectroscopy, William Kemp, 3rd edition, Macmillan, 2019.
- P.D. Sethi, Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd edition, CBS Publishers, 2019.
- D. C. Garrett, The quantitative Analysis of Drugs, 3rd edition, Springer, 1976.

BP812ET

DIETARY SUPPLEMENTS AND NUTRACEUTICALS (Theory) – ELECTIVE 45 Hours

Course Objectives:

This course covers foundational topics that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Course Outcomes:

Syllabus B.Pharm (PCI)



After completion of the course the students should be able to:

1. Understand the need of supplements by the different group of people to maintain healthy life.
2. Understand the outcome of deficiencies in dietary supplements.
3. Appreciate the components in dietary supplements and the application.
4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

Unit	Details	Hours
1	UNIT-I	10
	Definition of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds.	
2	UNIT-II	10
	Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature, medicinal benefits) of following: a) Carotenoids-α and β-Carotene, Lycopene, Xanthophylls, lutein b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Resveratrol. d) Flavonoids- Rutin, Naringin, Quercetin, Anthocyanidins, catechins, Flavones. e) Prebiotics/Probiotics: Fructooligosaccharides, Lactobacillum. f) Phytoestrogens: Isoflavones, daidzein, Genistein, lignans. g) Tocopherols. h) Proteins, vitamins, minerals, cereal, vegetables, and beverages as functional foods: oats, wheat bran, rice bran, seafoods, coffee, tea and the like.	
3	UNIT-III	10
	a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. b) Dietary fibres and complex carbohydrates as functional food ingredients.	
4	UNIT-IV	8
	a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radical theory of ageing. b) Antioxidants: Endogenous antioxidants – enzymatic and non-enzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione, Vitamin C, Vitamin E, α-Lipoic acid, melatonin. Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention.	
5	UNIT-V	7

Syllabus B.Pharm (PCI)



	a) Effect of processing, storage and interaction of various environmental factors on the potential of nutraceuticals. b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMP on Food Safety. Adulteration of foods. c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.	
	TOTAL	45

Recommended Books (Latest Edition to be adopted):

1. Sri Lakshmi B, Dietetics, 8th edition, New Age Publishers Pvt Ltd, 2014.
2. K. T. Agusti, P. Faizal and Paul Augustine, Role of dietary fibres and nutraceuticals in preventing diseases, BSP Books Pvt Ltd., 2018.
3. Cooper. K. A., Advanced Nutritional Therapies, 1st edition, Thomas Nelson Inc, United Kingdom, 1998.
4. Jean Carper, The Food Pharmacy, New Edition, Simon & Schuster, London, 2000.
5. James F. Balch and Phyllis A Balch, Prescription for Nutritional Healing, 2nd Edn, Avery Publishing Group, New York, 1997.
6. G. Gibson and C. Williams Editors, Functional foods Woodhead Publishing Company, 1st edition, London, 2000.
7. Goldberg, I., Functional Foods – Designer foods, Pharma foods, Nutraceuticals, Chapman and Hall, 1st edition, New York, 1994.
8. Labuza, T. P., Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf- Life Testing in Essentials of Functional Foods, M.K. Sachmidl and T. P. Labuza eds. 1st edition, Springer Publications, 2000.
9. Widman REC and Bruno RS, Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition), CRC Press, 2019.
10. Shils, ME, Olson, JA, Shike, M., Modern Nutrition in Health and Disease. eighth edition. Lea and Febiger. 1994.

BP813ET

PHARMACEUTICAL PRODUCT DEVELOPMENT (Theory) ELECTIVE

45 Hours

Course Objectives:

This course covers topics that will provide the learner with understanding of essential active and excipient studies required for pharmaceutical product development. The course will enable the learner to understand the step-by-step procedure to be followed towards developing a stable commercially viable product.

Course Outcomes:

After completing the course the students should be able to:

1. Apply different characterization techniques for evaluating API and excipients before the initiation of product development
2. Understand and devise strategies in designing stable commercially viable products
3. Understand the characterization of different dosage forms for essential quality parameters
4. Understand and devise protocols for development of products exhibiting regulatory compliance

CO-PO Mapping

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP813ET CO1	3	3	3	3	3	3	3	2	3	3	3
BP813ET CO2	3	3	3	3	3	3	3	2	3	3	3
BP813ET CO3	3	3	3	3	3	3	3	2	3	3	3
BP813ET CO4	3	3	2	3	3	3	3	3	3	3	3

While mapping Course Outcomes (CO) with POs the degree of associations are indicated as 3 (Strong), 2 (Moderate) and 1 (Weak). No relation -

Syllabus B.Pharm (PCI)



Unit	Details	Hours
1	UNIT-I	10
1.1	Introduction to pharmaceutical product development: Objectives, concept of product life cycle, regulations related to preformulation, formulation development, Purpose and role of IIG, stability assessment, manufacturing and quality control testing of different types of dosage forms.	
2	UNIT-II	10
2.1	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers. ii. Lipids, Cyclodextrins and their applications. iii. Non-ionic surfactants and their applications. iv. Polyethylene glycols and sorbitols. v. Suspending and emulsifying agents. vi. Semisolid excipients.	
3	UNIT-III	10
3.1	IPEC role and responsibility, Introduction to EXCIPACT- for excipient regulations. An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients. ii. Directly compressible vehicles. iii. Coat materials. iv. Excipients in parenteral and aerosol products. v. Excipients for formulation of NDDS. Selection and application of excipients in pharmaceutical formulations with specific industrial applications.	
4	UNIT-IV	8
	Optimization techniques in pharmaceutical product development. A study of various optimization techniques for pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development. Self-study on case studies based on QbD approach in development of solid, semisolid and parenteral dosage forms.	
5	UNIT-V	7
	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations. Regulatory considerations for product development pertaining to FDA guidelines- BCS classification and its importance with relevance to Biowaivers, Q1/Q2 approach in development of oral, dermal and injectable dosage forms.	
	TOTAL	45

Recommended Books (Latest edition to be adopted):

- Stanford Bolton and Charles Bon, Pharmaceutical Statistics Practical and Clinical Applications, 5th edition, CRC press, 2009.
- Encyclopedia of Pharmaceutical Technology, 6 volume set, edited by James Swarbrick, 3rd Edition, Informa Health.

Syllabus B.Pharm (PCI)



3. Roop K Khar, SP Vyas, Farhan J Ahmad, Gaurav K Jain, The Theory and Practice of Industrial Pharmacy, 4th Edition, CBS Publishers and Distributors Pvt. Ltd. 2013.
4. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
5. S. P. Vyas and R. K. Khar, Targeted and Controlled Drug Delivery, Novel Carrier Systems, CBS Publishers and Distributors Pvt. Ltd, 2019.
6. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Wilkins, USA, 2014.
7. Michael E. Aulton, Aulton's Pharmaceutics – The Design and Manufacture of Medicines, 4th Ed., 2013.
8. Gennaro A.R., Remington's: The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, Philadelphia, 2005.
9. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3 edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
10. Liberman H.A, Lachman L, Pharmaceutical dosage forms. Parenteral Medications, volume 1, 2, 3 edited by Avis K, Herbert A. Lieberman H. A. and Lachman L, Martin, M., 3rd edition, Marcel Dekker Inc. New York. 1993.
11. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3 edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
12. <https://ipcc-federation.org/>
13. <https://www.accessdata.fda.gov/scripts/cder/iig/index.cfm>
14. Advanced Review Articles related to the topics.

BP814PW

PROJECTWORK

180 Hours

Project is a requirement for the B. Pharm. degree, wherein under the guidance of a faculty member, a group of not more than five learners in the eighth semester, is required to do some innovative work with the application of knowledge gained while learning various courses in the earlier years. The area of the project shall be directly related to any one of the elective courses opted by the student in semester VIII. The learner/s is/are expected to do a survey of literature in the subject, work out a Project plan and carry it out through survey, experimentation and/or modelling / computation. Through the Project work the learner should exhibit skills for both analysis and critical thinking. The complete details of the project have to be submitted as a report of not less than 25 pages (A4, 1 inch margin, single line space, font Times Roman, font size 12, excluding count of reference pages) to the College before the prescribed date. The credits assigned for Project is 6 credits

BP814PW PROJECT WORK

Pharmaceutical Analysis

Course objective: To provide the learners with hands-on experience in applying the knowledge and skills to address real-world challenges or research questions, thereby enhancing their practical problem-solving abilities, fostering deeper understanding of the subject matter, and instilling teamwork and leadership qualities.

Course outcomes:

<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>
BP814PWCO1	Develop, plan and design project after identifying existing research gaps, by conducting an in-depth literature review, and collecting relevant data.
BP814PWCO 2	Formulate research objectives, hypotheses, and methodologies
BP814PWCO 3	Collect experimental data, analyze, tabulate data for effective presentation, and apply statistical analysis to interpret results.
BP814PWCO 4	Develop critical thinking skills to analyse experimental data, and provide practical and implementable suggestions.
BP814PWCO 5	Manage timelines, promote teamwork, and cultivate leadership skills, by overcoming project-related challenges.

CO-PO Mapping for BP706PS PRACTICE SCHOOL-PHARMACEUTICAL ANALYSIS

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3

BP814PW PROJECT WORK Pharmaceutics

Course Description:

This course is designed to provide comprehensive understanding of pharmaceutical product development and keep them updated with current pharmaceutical industrial procedures for formulation development.

Course Outcomes (CO):

Syllabus B.Pharm (PCI)



B. Pharm Final Year, Semester VIII

BP814PW PROJECT WORK (180 hours)

<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>
BP814PW CO1	Develop, plan and design project after identifying existing research gaps, by conducting an in-depth literature review, and collecting relevant data.
BP814PW CO2	Formulate research objectives, hypotheses, and methodologies.
BP814PW CO3	Collect experimental data, analyze, tabulate data for effective presentation, and apply statistical analysis to interpret results.
BP814PW CO4	Develop critical thinking skills to analyse experimental data and provide practical and implementable suggestions.
BP814PW CO5	Manage timelines, promote teamwork, and cultivate leadership skills, by overcoming project-related challenges.

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP814PW CO1	3	3	3	3	3	3	3	3	3	3	3
BP814PW CO2	3	3	3	3	3	3	3	3	3	3	3
BP814PW CO3	3	3	3	3	3	3	3	3	3	3	3
BP814PW CO4	3	3	3	3	3	3	3	3	3	3	3
BP814PW CO5	3	3	3	3	3	3	3	3	3	3	3

BP813PW PROJECT WORK Pharmaceutical Chemistry

Course Objectives:

The students should be able to study on multi-disciplinary areas related to pharmacy profession and gain more advanced knowledge of the research and manuscript writing. Develop required skills for technical presentation.

Course Outcomes: After the successful completion of course, the students will be able to-

<i>Course Code & CO number</i>	<i>At the successful completion of the course, the learners will be able to:</i>	<i>Up to Bloom's</i>
------------------------------------	--	----------------------

Syllabus B.Pharm (PCI)



		level
BP813PW CO1	Develop, plan and design project.	Level 4
BP813PW CO2	Identify existing research gaps.	Level 4
BP813PW CO3	Conduct an in-depth literature review, and collect relevant data for research project studies.	Level 4
BP813PW CO4	Formulate research objectives, hypotheses, and methodologies	Level 4
BP813PW CO5	Collect experimental data, analyse, and tabulate data for effective presentation.	Level 4
BP813PW CO6	Conduct statistical analysis and interpret results.	Level 4
BP813PW CO7	Develop critical thinking skills to analyse complex data.	Level 5
BP813PW CO8	Provide practical and implementable suggestions.	Level 5
BP813PW CO9	Optimise resource utilisation for project outcomes.	Level 5
BP813PW CO10	Manage timelines and overcome project-related challenges.	Level 5
BP813PW CO11	Collaborate with peers, mentors, and experts to foster a multidisciplinary/transdisciplinary approach to research.	Level 6

Course code & CO number	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
BP813PW CO1	2	0	1	1	0	1	1	1	0	0	1
BP813PW CO2	1	0	1	0	0	1	1	1	1	0	1
BP813PW CO3	1	1	0	2	1	0	1	1	0	0	1
BP813PW CO4	1	0	0	0	1	1	1	1	0	0	0
BP813PW CO5	1	1	1	0	2	2	1	1	1	0	0
BP813PW CO6	1	0	0	0	1	2	1	1	0	0	0
BP813PW CO7	1	1	1	2	2	1	0	1	0	0	1
BP813PW CO8	2	1	0	1	0	0	0	0	0	0	0
BP813PW CO9	1	1	1	0	0	0	1	1	0	0	1
BP813PW CO10	0	1	0	2	1	1	1	1	1	0	1
BP813PW CO11	1	2	0	0	1	0	1	1	0	0	1

BP814PW PROJECT WORK

Pharmacology

Course Objectives:

This course aims to offer students hands-on learning opportunities in the field of Pharmacology, with a focus on Pharmacology, Toxicology, and Molecular Biology-related processes. It also facilitates learning experiences related to conducting literature reviews and analyzing them to draw comparisons and contrasts with existing scientific knowledge. Additionally, students will gain an understanding of how to identify a scientific problem and to create scientific reports, utilizing ICT tools, illustrations, graphical data representation, and plagiarism detection software, all of which will enhance their insights into the field of Pharmacology.

Syllabus B.Pharm (PCI)



B. Pharm Final Year, Semester VIII BP813PW PROJECT WORK (PRACTICAL- 180 hours)

BP814PW Course Outcomes	At the successful completion of the course, the learners will be able to:
BP814PW CO 1	Understand the research problem identified.
BP814PW CO 2	Perform a literature review for the identified research issue by exploring sources like Pubmed, Google Scholar, and Scopus, and structure the primary and secondary literature review that was carried out.
BP814PW CO 3	Analyze the data gathered and draw conclusions regarding the research problem based on the analysis conducted.
BP814PW CO 4	Apply statistical analysis methods to the obtained data and illustrate the results using tables, graphs, and schematic diagrams.
BP814PW CO 5	Generate a collective research project report by leveraging the insights obtained through Microsoft Excel and Microsoft Office applications (Information and Communication Technology tools) to create a research report that addresses the identified research problem.
BP814PW CO 6	Assess the group-created project report using plagiarism detection software.

Mapping CO-PO

BP814PW Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3	3	3	3	3