CENTRAL UNIVERSITY OF PUNJAB

Bachelor of Pharmacy

Session-2025-29

Department of Pharmaceutical Sciences and Natural Products

Course structure for B. Pharmacy

Semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total Marks
BP101T	Human Anatomy and Physiology I– Theory	3	1	4	100
BP102T	Pharmaceutical Analysis I–Theory	3	1	4	100
BP103T	Pharmaceutics I– Theory	3	1	4	100
BP104T	Pharmaceutical Inorganic Chemistry– Theory	3	1	4	100
BP105T	Communication skills–Theory	2	-	2	50
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics– Theory	2	-	2	50
BP107P	Human Anatomy and Physiology– Practical	4	-	2	50
BP108P	Pharmaceutical Analysis I–Practical	4	-	2	50
BP109P	Pharmaceutics I– Practical	4	-	2	50
BP110P	Pharmaceutical Inorganic Chemistry– Practical	4	-	2	50
BP111P	Communication skills–Practical	2	-	1	25
BP112RBP	Remedial Biology– Practical	2	-	1	25
Total		**32/34*/36****	**4**	**27/29*/30****	**675/725*/750****

**Applicable ONLY for the students who have studied Mathematics/Physics/Chemistry at HSC and appearing for Remedial Biology (RB) course.

*Applicable ONLY for the students who have studied Physics/Chemistry/Botany/Zoology at HSC and appearing for Remedial Mathematics (RM) course.

Semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP201T	Human Anatomy and Physiology II– Theory	3	1	4	100
BP202T	Pharmaceutical Organic Chemistry I– Theory	3	1	4	100
BP203T	Biochemistry–Theory	3	1	4	100
BP204T	Pathophysiology–Theory	3	1	4	100
BP205T	Computer Applications in Pharmacy– Theory	3	-	3	75
BP206T	Environmental sciences–Theory	3	-	3	75
BP207P	Human Anatomy and Physiology-II– Practical	4	-	2	50
BP208P	Pharmaceutical Organic Chemistry-I– Practical	4	-	2	50
BP209P	Biochemistry–Practical	4	-	2	50
BP210P	Computer Applications in Pharmacy– Practical	2	-	1	25
	Total	**32**	**4**	**29**	**725**

Semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP301T	Pharmaceutical Organic Chemistry II– Theory	3	1	4	100
BP302T	Physical Pharmaceutics I–Theory	3	1	4	100
BP303T	Pharmaceutical Microbiology–Theory	3	1	4	100
BP304T	Pharmaceutical Engineering–Theory	3	1	4	100
BP305P	Pharmaceutical Organic Chemistry II– Practical	4	-	2	50
BP306P	Physical Pharmaceutics I–Practical	4	-	2	50
BP307P	Pharmaceutical Microbiology–Practical	4	-	2	50
BP308P	Pharmaceutical Engineering–Practical	4	-	2	50
	Total	**28**	**4**	**24**	**600**

Semester-IV

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4	100
BP402T	Medicinal Chemistry I–Theory	3	1	4	100
BP403T	Physical Pharmaceutics II–Theory	3	1	4	100
BP404T	Pharmacology I–Theory	3	1	4	100
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4	100
BP406P	Medicinal Chemistry I–Practical	4	-	2	50
BP407P	Physical Pharmaceutics II–Practical	4		2	50
BP408P	Pharmacology I–Practical	4	-	2	50
BP409P	Pharmacognosy and Phytochemistry I– Practical	4	-	2	50
	Total	**31**	**5**	**28**	**700**

Semester-V

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP501T	Medicinal Chemistry II–Theory	3	1	4	100
BP502T	Industrial Pharmacy I–Theory	3	1	4	100
BP503T	Pharmacology II–Theory	3	1	4	100
BP504T	Pharmacognosy and Phytochemistry II– Theory	3	1	4	100
BP505T	Pharmaceutical Jurisprudence– Theory	3	1	4	100
BP506P	Industrial Pharmacy I–Practical	4	-	2	50
BP507P	Pharmacology II–Practical	4	-	2	50
BP508P	Pharmacognosy and Phytochemistry II– Practical	4	-	2	50
	Total	**27**	**5**	**26**	**650**

Semester- VI

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP601T	Medicinal Chemistry III–Theory	3	1	4	100
BP602T	Pharmacology III –Theory	3	1	4	100
BP603T	Herbal Drug Technology–Theory	3	1	4	100
BP604T	Biopharmaceutics and Pharmacokinetics– Theory	3	1	4	100
BP605T	Pharmaceutical Biotechnology– Theory	3	1	4	100
BP606T	Quality Assurance–Theory	3	1	4	100
BP607P	Medicinal chemistry III–Practical	4	-	2	50
BP608P	Pharmacology III– Practical	4	-	2	50
BP609P	Herbal Drug Technology– Practical	4	-	2	50
	Total	**28**	**6**	**30**	**750**

Semester- VII

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP701T	Instrumental Methods of Analysis –Theory	3	1	4	100
BP702T	Industrial Pharmacy II–Theory	3	1	4	100
BP703T	Pharmacy Practice–Theory	3	1	4	100
BP704T	Novel Drug Delivery System– Theory	3	1	4	100
BP705P	Instrumental Methods of Analysis– Practical	4	-	2	50
BP706PS	Practice School	12	-	6	150
	Total	**28**	**4**	**24**	**600**

Semester- VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points	Total marks
BP801T	Biostatistics and Research Methodology	3	1	4	100
BP802T	Social and Preventive Pharmacy	3	1	4	100
BP803ET	PharmaMarketing Management	3+3=6*	1+1=2*	4+4=8*	100 +100 =200
BP804ET	Pharmaceutical Regulatory Science				
BP805ET	Pharmacovigilance				
BP806ET	Quality Control and Standardization of Herbals				
BP807ET	Computer Aided Drug Design				
BP808ET	Cell and Molecular Biology				
BP809ET	Cosmetic Science				
BP810ET	Experimental Pharmacology				
BP811ET	Advanced Instrumentation Techniques				
BP812ET	Dietary Supplements and Nutraceuticals				
BP813PW	Project Work	12	-	6	150
	Total	**24**	**4**	**22**	**550**

*calculated for any two elective courses from BP803ET-BP812ET

Semester wise credits distribution

Semester	Credit Points
I	**27/29$/30#**
II	29
III	26
IV	28
V	26
VI	26
VII	24
VIII	22
Extracurricular/Co-curricular-activities	01
Total credit points for the program	**209/211*/212****

*Applicable ONLY for the students studied Physics/ Chemistry/ Botany/ Zoology at HSC and appearing for Remedial Mathematics course.

**Applicable ONLY for the students studied Mathematics/ Physics / Chemistry at HSC and appearing for Remedial Biology course.

Examination pattern

Core, Discipline Elective, Compulsory Foundation,		
	Marks	**Evaluation**
Internal Assessment	25%	Various methods
Mid-semester test (MST)	25%	Descriptive
End-semester test (EST)	50%	Descriptive (70%) Objective (30%)

Objective Questions- one-word/sentence answers, fill-in the blanks, MCQs', and matching

Descriptive Questions- Short answer and essay type questions

Internal assessment- any two or more of the given methods: Surprise Tests, open book examination, assignments, term paper, etc.).

Evaluation criteria for practical:

Item	**Synopsis**	**Performance**	**Practical Note book and continuous evaluation**	**Viva voce**
Marks	10	20	10	10

Project/Report writing/Practise School		
	Marks	**Evaluation**
Supervisor	75	Continuous assessment (regularity in work, mid- term evaluation report-presentation, final viva-voce
External expert, HoD and senior-most faculty of the department	75	Report (25), presentation (25), final viva-voce (25)

Semester - I

Human Anatomy and Physiology-I

Course Code: BP101T

L -3	T-1	P-0

Credits: 04

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand anatomical terms to recognize and characterize positions of major organs of human body systems
CLO2	Apply medical terminology and functionality of body systems in health education and health promotion.
CLO3	Analyze disorders of skeletal muscle, smooth muscle, cardiovascular system, lymphatic system and digestive system.
CLO4	Evaluate Bleeding time, clotting time, Blood group of various individuals
CLO5	Develop advanced physiological and health-related test using their skills

Course Content:

Unit/Hours	Contents	Mapping
Unit-1 **10 hours**	**Introduction to human body** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **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 by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b)Paracrine c)Synaptic d)Endocrine **Tissue level of organization**	**CLO1 and CLO2**

	Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues	
Unit-2 10hrs.	**Integumentary system**: Structure and functions of skin **Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction **Joints**: Structural and functional classification, types of joints movements and its articulation	**CLO1 and CLO3**
Unit-3 10hrs	**Body fluids and blood** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo- endothelial system. **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system	**CLO3 and CLO4**
Unit-4 8 hrs	**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. **Special senses** Structure and functions of eye, ear, nose and tongue and their disorders.	**CLO1**
Unit-5 7hrs	**Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart	**CLO1, CLO3 and CLO5**

Human Anatomy and Physiology I (Practical)

Course Code: BP101T

Credits: 4

L -0	T-0	P-4

Course Learning Outcomes:

On the successful completion of his course, students will be able to:

CLO	Statement
CLO1	Understand the construction, working, care and handling of instruments, glassware and equipment required for practical
CLO2	Apply body fluids and blood knowledge in Hemoglobin detection and measurement of blood pressure.
CLO3	Analyze working pattern of different organs of each system.
CLO4	Evaluate pulse rate, heart rate, erythrocyte sedimentation rate
CLO5	Develop reports of white blood cells and red blood cells count

Course Content:

PRACTICAL	TITLE	MAPPING
1	Study of compound microscope	**CLO1**
2	Microscopic study of epithelial and connective tissue	**CLO1, CLO3**
3	Microscopic study of muscular and nervous tissue	**CLO1, CLO3**
4	Identification of axial bones	**CLO3**
5	Identification of appendicular bones	**CLO3**
6	Introduction to hemocytometry	**CLO1, CLO2**
7	Enumeration of white blood cell (WBC) count	**CLO1, CLO5**

8	Enumeration of total red blood corpuscles (RBC) count	**CLO5**
9	Determination of bleeding time	**CLO2**
10	Determination of clotting time	**CLO2**
11	Estimation of hemoglobin content	**CLO2**
12	Determination of blood group	**CLO2**
13	Determination of erythrocyte sedimentation rate (ESR)	**CLO4**
14	Determination of heart rate and pulse rate	**CLO4**
15	Recording of blood pressure	**CLO4**

Recommended Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam, 8th edition, Jaypee brother's medical publishers, New Delhi, 2019.

2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, 12th edition, Churchill Livingstone, New York, 2014.

3. Physiological basis of Medical Practice-Best and Tailor, 13th edition, Williams & Wilkins Co, Riverview, MI USA, 1979.

4. Text book of Medical Physiology- Arthur C, GuytonandJohn.E. Hall. 14th edition, Miamisburg, OH, USA, 2020.

5. Principles of Anatomy and Physiology by Tortora Grabowski. 15th edition Palmetto, GA, USA, 2017.

6. Textbook of Human Histology by Inderbir Singh, 9th edition, Jaypee brother's medical publishers, New Delhi, 2019

7. Textbook of Practical Physiology by C.L. Ghai, 9th edition, Jaypee brother's medical publishers, New Delhi, 2018.

8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, 2nd edition, Jaypee brother's medical publishers, New Delhi, 2018.

Reference Books

1. Physiological basis of Medical Practice-Best and Tailor, 13th edition, Williams & Wilkins Co, Riverview, MI USA, 1979.

2. Text book of Medical Physiology- Arthur C, GuytonandJohn.E. Hall. 14th edition, Miamisburg, OH, USA, 2020.

3. Human Physiology, 14th edition (vol 1 and 2) by Dr. C.C. Chatterrje , CBS Publishers & Distributors Pvt.Ltd, 2022.

Pharmaceutical Analysis I

Course Code: BP102T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand qualitative, quantitative and semi-quantitative estimation.
CLO2	Comprehend the principles, methodology of different types of titration and electrochemical analysis.
CLO3	Develop analytical skills.
CLO4	Check the purity and strength of the drug formulations.
CLO5	Cognize the different separation techniques and their applications in analysis of drugs

Course Content

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**(a) Pharmaceutical analysis**- Definition and scope i) Different techniques of analysis ii) Methods of expressing concentration 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	**CLO1**

	(b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures **(c)** Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.	
Unit-2 **10 hrs**	**Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	**CLO2, CLO3, CLO4**
Unit-3 **10 hrs**	**Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration.	**CLO2, CLO3, CLO5**
Unit-4 **8hrs**	**Redox titrations** (a) Concepts of oxidation and reduction (b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate	**CLO2, CLO3**
Unit-5 **7hrs**	**Electrochemical methods of analysis** **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications.	**CLO2, CLO3, CLO5**

	Potentiometry-Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography**-Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications	

Pharmaceutical Analysis (Practical)

Course Code: BP108P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Perform limit test, preparation, standardization and determination of Normality.
CLO2	Carryout various volumetric and electrochemical titrations.
CLO3	Develop analytical skills.
CLO4	Cognize the different separation techniques and their applications in analysis of drugs

Course Content:

PRACTICAL	TITLE	MAPPING
1	**Limit Test of the following:** (1) Chloride (2) Sulphate (3) Iron (4) Arsenic	**CLO1**
2	**Preparation and standardization of:** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate	**CLO1, CLO3**
3	**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 (4) Calcium gluconate by complexometry(5) Hydrogen peroxide by Permanganometry(6)Sodium benzoate by	**CLO1, CLO3**

	non-aqueous titration (7) Sodium Chloride by precipitation titration	
4	**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	**CLO2, CLO4**

Recommended Books:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, 4th edition part-2, Stahlone Press of University of London, 2000.

2. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, Pearson Education; 6th edition, 2009.

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd edition, Valllabh Prakashan, 2010.

4. Bentley and Driver's, Textbook of Pharmaceutical Chemistry, 8th edition, Oxford University Press, 2020.

5. John H. Kennedy, Analytical chemistry principles, 2nd edition, Cengage, India, 2011.

6. Indian Pharmacopoeia 2022, 9th edition, By Indian Pharmacopoeia Commission.

PHARMACEUTICS- I

Course Code: BP103T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the professional way of handling the prescription
CLO2	Apply various additives and technical terms commonly used in the field of Pharmacy.
CLO3	Analyze the Knowledge about the Pharmacopoeias and the role of Pharmacist
CLO4	Understand the various methods and formulas used in different calculation used during formulation and their analysis or standardization
CLO5	Create the formulation,sterilization and stability of various conventional different dosage forms

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	•**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. •**Dosageforms:** 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.	**CLO1, CLO2, CLO3**

Unit-2 **10 hrs**	•**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	**CLO4, CLO5**
Unit-3 **8hrs**	•**Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, 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 agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.	**CLO5**
Unit-4 **8hrs**	•**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.	**CLO5**
Unit-5	•**Semisolid dosage forms**: Definitions, classification, mechanisms and factors influencing	**CLO5**

7hrs	dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	

Pharmaceutics-I (Practical)

Course Code: BP109P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the concepts of formulation and use of different ingredients in different dosage forms
CLO2	Able to prepare the formulations and evaluate the Pharmacopeial standards for the preparation of various dosages forms

Course Content:

PRACTICAL	TITLE	MAPPING
1	**Syrups:** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68	**CLO1, CLO2**
2	**Elixirs:** a) Piperazine citrate elixir b) Paracetamol pediatric elixir	**CLO2**
3	**Linctus:** a) Terpin Hydrate Linctus IP'66[22] b) Iodine Throat Paint (Mandles Paint)	**CLO2**
4	**Solutions:** a) Strong solution of ammonium acetate b) Cresol with soap solution	**CLO2**

	c) Lugol's solution	
5	**Suspensions:** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel	**CLO2**
6	**Emulsions:** a) Turpentine Liniment b) Liquid paraffin emulsion	**CLO2**
7	**Powders and Granules:** a) ORS powder (WHO) b) Effervescent granules c) Dusting powder d) Divded powders	**CLO2**
8	**Suppositories:** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository	**CLO2**
9	**Semisolids:** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel	**CLO2**
10	**Gargles and Mouthwashes:** a) Iodine gargle b) Chlorhexidine mouthwash	**CLO2**

Recommended Books:

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, 11th edition, Lippincott Williams and Walkins, New Delhi, 2018.

2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, 12th edition, CBS publishers, New Delhi, 2008.

3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, 7th edition, Churchill Livingstone, Edinburgh, 1988.

4. Indian Pharmacopoeia 2022, 9th edition, By Indian Pharmacopoeia Commission.

5. British pharmacopoeia 2024.

6. Lachmann. Theory and Practice of Industrial Pharmacy, 4th edition, CBS Publication, 2020.

7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, 20th edition, Lippincott Williams, New Delhi, 2000.

8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 12th edition, CBS Publications, New Delhi, 2008.

9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, 1st edition, Elsevier Health Sciences, USA, 2011.

10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, 1st edition, CRC Press Inc., 1989.

11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, 4th edition, CRC press, 2021.

12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, 1st edition, CRC press, 2000.

Pharmaceutical Inorganic Chemistry

Course Code: BP104T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Deals with monograph of inorganic drug and pharmaceutics.
CLO2	Recognize acid base and buffers.
CLO3	Familiarize with a variety of inorganic drug classes
CLO4	Clarify topical agents, gases and vapors, dental products and radiopharmaceuticals
CLO5	Get awareness about the sources of impurities

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	•**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 25 **General methods of preparation,** assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes.	**CLO1, CLO5**
Unit-2 **10 hrs**	•**Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of	**CLO2, CLO3**

	tonicity, calculations and methods of adjusting isotonicity. •**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. •**Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	
Unit-3 **10 hrs**	•**Gastrointestinal agents** •**Acidifiers:** Ammonium chloride* and Dil. HCl •**Antacid:** Ideal properties of antacids, combinations 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	**CLO3**
Unit-4 **8 hrs**	**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 nitrite333 •**Astringents:** Zinc Sulphate, Potash Alum	**CLO3, CLO4**

Unit-5 **7 hrs**	•**Radiopharmaceuticals:** Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes- Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.	**CLO4**

PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

Course Code: BP110P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Know about identification, purity and limit tests.
CLO2	Develop information of preparation of inorganic pharmaceuticals
CLO3	Get Awareness about the sources of impurities
CLO4	Acquire Knowledge about methods of determination of the impurities in inorganic drugs and pharmaceuticals
CLO5	Familiarize with a variety of inorganic drug classes

Course Content:

PRACTICAL	TITLE	MAPPING
1	**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	**CLO1, CLO4**
2	**Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate	**CLO1, CLO4, CLO5**

	Calcium gluconate Copper sulphate	
3	**Test for purity** Swelling power of Bentonite Neutralizingcapacity ofaluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide	**CLO1, CLO5**
4	**Preparation of inorganic pharmaceuticals:** Boric acid Potash alum Ferrous sulphate	**CLO2, CLO5**

Recommended Books

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition, 2000.

2. A.I. Vogel, Text Book of Quantitative Inorganic Analysis, Pearson Education; 6th edition, 2009.

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd edition, Valllabh Prakashan, 2010.

4. M.LSchroff, Inorganic Pharmaceutical Chemistry, volume 2, National book centre, 1968.

5. Bentley and Driver's, Textbook of Pharmaceutical Chemistry, 8th edition, Oxford University Press, 2020.

6. G. R. Chatwal, Pharmaceutical Chemistry Inorganic, volume 1, Himalaya Publishing house, 2010.

7. Indian Pharmacopoeia 2022, 9th edition, By Indian Pharmacopoeia Commission.

COMMUNICATION SKILLS

Course Code: BP105T

Credits: 02

L -2	T-0	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Communicate effectively (Verbal and Non-Verbal)
CLO2	Comprehend the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation.
CLO3	Develop interview skills
CLO4	Improve proof-readings kills and language awareness so that one can spot mistakes and correct their own work
CLO5	Improve writing skills

Course content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **7hrs**	•**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process– Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context •**Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers •**Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective- Past Experiences, Prejudices, Feelings, Environment	**CLO1**
Unit-2	•**Elements of Communication:** Introduction, Face to Face Communication- Tone of Voice, Body Language	**CLO1**

7hrs	(Non-verbal communication), Verbal Communication, Physical Communication •**Communication Styles:** Introduction, The Communication Styles Matrix with example for each- Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	
Unit-3 **7hrs**	•**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations •**Effective Written Communication:** Introduction, When and When Not to Use Written Communication- Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication •**Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	**CLO4, CLO5**
Unit-4 **5hrs**	•**Interview Skills:** Purpose of an interview, Do's and Don'ts of an interview •**Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	**CLO2, CLO3**
Unit-5 **4hrs**	•**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	**CLO3**

COMMUNICATION SKILLS (practical)

Course Code: BP111P

Credits: 01

L -0	T-0	P-2

Course Learning Outcomes:

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

CLO	Statement
CLO1	Establish the team as an effective team player
CLO2	Acquire modules that are to be conducted using English language lab software..
CLO3	Comprehend the behavioral needs for a Pharmacist to function efficiently

Course Content:

PRACTICAL	TITLE	MAPPING
1	**Basic communication covering the following topics** Meeting People Asking Questions Making Friends What did you do? Do's and Dont's	**CLO1**
2	**Pronunciations covering the following topics** Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds)	**CLO2**
3	**Advanced Learning** Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication	**CLO2, CLO3**

	Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills	

Recommended Books

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011

2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011

3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013

4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5.The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala SwamyRamesh, 5thEdition, Pearson, 2013

6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010

7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals PHI, 2011

8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011

9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning indiapvt.ltd, 2011

10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011

11. Effective communication, John Adair, 4thEdition, Pan Mac Millan, 2009

12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

REMEDIAL BIOLOGY

Course Code: BP106RBT

Credits: 02

L -2	T-0	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the basic concept of taxonomy
CLO2	Study plant morphology including the morphology of flowering plant.
CLO3	Understand Cell biology (Basic Nature of Plant cell and Animal cell) Be familiar with various body fluids
CLO4	Understand the basic physiology of animals and plants

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **7hrs**	**Living world:** • Definition and characters of living organisms •Diversity in the living world • Binomial nomenclature • Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus. **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 & Dicotylidones.	**CLO1, CLO2**
Unit-2 **7hrs**	**Body fluids and circulation:** • Composition of blood, blood groups, coagulation of blood	**CLO3, CLO4**

	• Composition and functions of lymph •Human circulatory system • Structure of human heart and blood vessels • 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	
Unit-3 **7hrs**	**Excretory products and their elimination**: • Modes of excretion •Human excretory system- structure and function • Urine formation • Rennin 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	**CLO4**

	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	
Unit-4 **5hrs**	**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.	**CLO3, CLO4**
Unit-5 **4hrs**	**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 organelles, Cell division **Tissues:** • Definition, types of tissues, location and functions.	**CLO3, CLO4**

REMEDIAL BIOLOGY (practical)

Course Code: BP112RBP

Credits: 01

L -0	T-0	P-2

Course Learning Outcomes:

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

CLO	STATEMENT
CLO1	Understand microscopic study and identification of tissues, Study of cell, Stem, Root, Leaf, seed, fruit, and flower.
CLO2	Carry out detailed study of animals by using computer models
CLO3	Perform determination of blood group and check blood pressure and tidal volume.

Course Content:

PRACTICAL	TITLE	MAPPING
1	1. **Introduction to experiments in biology** a) Study of Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation	**CLO1**
2	Study of cell and its inclusions	**CLO1**
3	Study of Stem, Root, Leaf, seed, fruit, flower and their modifications	**CLO1**
4	Detailed study of frog by using computer models	**CLO2**

5	Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower	**CLO1**
6	Identification of bones	**CLO2**
7	Determination of blood group	**CLO3**
8	Determination of blood pressure	**CLO3**
9	Determination of tidal volume	**CLO3**

Reference Books:

1. Practical human anatomy and physiology. by S.R. Kale and R.R. Kale, Nirali Parkashan, 2017.

2. A Manual of pharmaceutical biology practical by S.B. Gokhale, C.K. Kokate and S.P. Shriwastava, 5th edition, Nirali Parkashan, 2007.

3. Biology practical manual according to National core curriculum. Biology forum of Karnataka. Prof .M.J.H. Shafi

REMEDIAL MATHEMATICS

Course Code: BP106RMT

Credits: 02

L -2	T-0	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Deal with introduction of partial fraction, logarithm, matrix, Calculus.
CLO2	Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.
CLO3	Create, use and analyze mathematical representations and mathematical relationships
CLO4	Communicate mathematical knowledge and understanding to help in the field of Clinical Pharmacy

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **6hrs**	•**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 •**Logarithms** 39 Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.	**CLO1, CLO2**

	•**Function:** Real Valued function, Classification of real valued functions, •**Limits and continuity:** Introduction , Limit of a function, Definition of limit of a function	
Unit-2 **6hrs**	•**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 of 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	**CLO3**
Unit-3 **6hrs**	• **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.tx,where n is any rational number, Derivative of e x ,, Derivative of loge x , Derivative of a x ,Derivative of trigonometric functions from first principles (without Proof), Successive Differentiation, Conditions	**CLO3**

	for a function to be a maximum or a minimum at a point. Application	
Unit-4 **6hrs**	•**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	**CLO3**
Unit-5 **6hrs**	•**Differential Equations :** Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations •**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	**CLO3, CLO4**

Recommended Books

1. Differential Calculus by Shanthinarayan, 15th edition, S. Chand, 1942

2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H., Pharmamed Press, 2014.

3. Integral Calculus by Shanthinarayan, 1st edition, S. Chand, 1942.

4. Higher Engineering Mathematics by Dr.B.S. Grewal, Standard edition, Khanna Publishers, 1965.

SEMESTER: II

Human Anatomy and Physiology II

COURSE CODE: BP 201T

Credits: 04

L	T	P
3	1	0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Know about the various tissues and organs of different systems of human body.
CLO2	Analyze the relevance and significance of Human Anatomy and Physiology to Pharmaceutical Sciences
CLO3	Understand the basic terms and concepts of genetics

Course Content

UNIT/HOURS	CONTENT	MAPPING
UNIT 1 10 hours	• Nervous system Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, 44 synapse, neurotransmitters. Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid. structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)	**CLO1**

UNIT II 06 hours	•Digestive system Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. • Energetics Formation and role of ATP, Creatinine Phosphate and BMR.	**CLO1, CLO2**
UNIT III 10 hours	• Respiratory system Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. • Urinary system Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.	**CLO1, CLO2**
UNIT IV 10 hours	• Endocrine system Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.	**CLO1, CLO2**
UNIT V 09 hours	• 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.	**CLO2, CLO3**

	• Introduction to genetics Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance.	

Recommended Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi. 9th edition, 2022.

2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York. 12th edition, 2018.

3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA 56 .13th edition, 2011.

4. Text book of Medical Physiology- Arthur C, GuytonandJohn.E. Hall. Miamisburg, OH, U.S.A, 14th edition, 2020.

5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 15th edition, 2018.

6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi. 10th edition, 2023.

7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi. 10th edition, 2022.

8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi. 2nd edition, 2018.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA. 13th edition, 2011.

2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A. 14th edition, 2020.

3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata . 14th edition, 2022.

HUMAN ANATOMY AND PHYSIOLOGY (Practical)

COURSE CODE: BP 201T

L	T	P
3	1	0

Credit: 4

Course Outcomes:

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

CLO	Statement
CLO1	Know about the various tissues and organs of different systems of human body.
CLO2	Analyze the relevance and significance of Human Anatomy and Physiology to Pharmaceutical Sciences
CLO3	Perform the hematological tests like blood cell counts, hemoglobin estimation etc and also record blood pressure, heartrate, pulse and respiratory volume
CLO4	Inspect Homeostatic mechanisms and their imbalances in the human body
CLO5	Understand the use of diagnostic kits and various ways of family planning and

Course content:

PRACTICAL	TITLE	MAPPING
1.	To study the integumentary and special senses using specimen, models, etc.	**CLO1**
2.	To study the nervous system using specimen, models, etc.	**CLO2**
3.	To study the endocrine system using specimen, models, etc.	**CLO2**
4.	To demonstrate the general neurological examination.	**CLO2**
5.	To demonstrate the function of olfactory nerve.	**CLO2, CLO3**
6.	To examine the different types of taste.	**CLO1, CLO3**
7.	To demonstrate the visual acuity.	**CLO3**

8.	To demonstrate the reflex activity.	**CLO3**
9.	Recording of body temperature.	**CLO3, CLO4**
10.	To demonstrate positive and negative feedback mechanism.	**CLO4**
11.	Determination of tidal volume and vital capacity.	**CLO3**
12.	Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.	**CLO1, CLO2**
13.	Recording of basal mass index.	**CLO4**
14.	Demonstration of total blood count by cell analyser.	**CLO3**
15.	Permanent slides of vital organs and gonads.	**CLO2, CLO3**
16.	Study of family planning devices and pregnancy diagnosis test	**CLO5**

PHARMACEUTICAL ORGANIC CHEMISTRY

Course Code: BP202T

L	T	P
3	1	0

Credits: 04

Course Outcomes:

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

CLO	Statement
CLO1	Learn the classification of organic compounds on the basis of functional group and IUPAC nomenclature of different organic compounds.
CLO2	Apply concepts of organic chemistry related to hybridization, types of bonds and isomerism, Methods of preparation, elimination and addition reactions of different compounds.
CLO3	Identify/confirm the identification of organic compound.
CLO4	Examine various techniques of purification of the synthesized compounds using precipitation or recrystallization.
CLO5	Explore molecules and compounds.

Course Content:

UNITS/HOURS	CONTENT	MAPPING
UNIT I **07 Hours**	**•Classification, nomenclature and isomerism** Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerism's in organic compounds	**CLO1,CLO2**

UNIT II **10 Hours**	•**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, Saytzeffs orientation and evidences. E1 verses 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	**CLO1, CLO2**
UNIT III **10 Hours**	•**Alkyl halides** SN^1 and SN^2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbonations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions. Structure and uses of ethylchloride, 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	**CLO2, CLO3**
UNIT IV **10 Hours**	•**Carbonyl compounds (Aldehydes and ketones)** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation,	**CLO3, CLO5**

	qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.	
UNIT V **08 Hours**	• **Carboxylic acids** 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 Acetyl salicylic acid •**Aliphatic amines**- Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine.	**CLO4, CLO5**

PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)

Course Code: BP208P

Credits: 04

L-0	T-0	P-4

Course Outcomes:

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

CLO	Statement
CLO1	Understand the principle behind various qualitative tests and analyze the given unknown organic compound having different functional groups
CLO2	Apply various laboratory techniques for the synthesis of organic compounds, purification of the synthesized compounds using precipitation or recrystallization.
CLO3	Analyze organic compounds qualitatively, synthesis of derivatives.
CLO4	Evaluate correct use of various equipment & Safety measures in Pharmaceutical Chemistry laboratory.
CLO5	Understand creation of polymers, like plastics and nylons

PRACTICAL	TITLE	MAPPING
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. Melting point/Boiling point of organic compounds.	**CLO1, CLO3**

	6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point. 8. Minimum 5 unknown organic compounds to be analysed systematically.	
2.	Preparation of suitable solid derivatives from organic compounds.	**CLO2, CLO3**
3.	Construction of molecular models.	**CLO4, CLO5**

Recommended Books

1. Organic Chemistry by Morrison and Boyd, 7th edition, 2010.

2. Organic Chemistry by I.L. Finar , Volume-I. 6th edition, 2002.

3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl. 22nd edition, 2019.

4. Organic Chemistry by P.L.Soni, 29th edition, 2012.

5. Practical Organic Chemistry by Mann and Saunders. 4th edition, 2009.

6. Vogel's text book of Practical Organic Chemistry, 5th edition, 2003.

7. Advanced Practical organic chemistry by N.K.Vishnoi. 3rd edition, 2010.

8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz. 3rd edition, 2010.

9. Reaction and reaction mechanism by Ahluwaliah/Chatwal. 4th edition, 2010.

BIOCHEMISTRY (Theory)

COURSE CODE: BP203 T

Credits: 04

L-3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Recognize role of biochemical processes and cell metabolism.
CLO2	Implement basics like chemistry, function, classification, biological importance, Qualitative tests & applications of various biomolecules. e.g. proteins, carbohydrates and lipids etc.
CLO3	Detect and identify proteins, amino acids and carbohydrates by various qualitative as well as quantitative tests.
CLO4	Estimate the fundamental of metabolism, process, steps involved in metabolism of carbohydrates, lipids, protein and nucleic acid.
CLO5	Design and perform tests used to detect infections, genetic disorders, and other diseases

Course Content:

UNITS/HOURS	CONTENT	MAPPING
UNIT I **08 HOURS**	•**Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. 54 •**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.	**CLO1**

UNIT II **10 HOURS**	•**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 level phosphorylation Inhibitors ETC and oxidative phosphorylation/ Uncouplers	**CLO2, CLO3, CLO4**
UNIT III **10 HOURS**	•**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. •**Amino acid metabolism** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders	**CLO2, CLO3, CLO4**

	Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice.	
UNIT IV **10 HOURS**	•**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 (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors	**CLO4, CLO5**
UNIT V **07 HOURS**	•**Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions	**CLO1, CLO5**

BIOCHEMISTRY (Practical)

COURSE CODE: BP209P

Credits: 02

L-0	T-0	P-4

Course Outcomes:

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

CLO	Statement
CLO1	Develop skill for qualitative analysis of carbohydrates, Proteins, urine, enzymes
CLO2	Apply the skills for physiological and pathological condition of chemicals.
CLO3	Analyze the interpretation of data emanating from a Clinical Test Lab.
CLO4	Evaluate physiological conditions, influence the structures and re-activities of biomolecules
CLO5	Construct test used to detect infections, genetic disorders and other diseases

Course Content:

PRACTICAL	TITTLE	MAPPING
1	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch).	**CLO1, CLO4**
2	Identification tests for Proteins (albumin and Casein).	**CLO1, CLO4**
3	Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method).	**CLO1, CLO4**
4	Qualitative analysis of urine for abnormal constituents.	**CLO5**
5	Determination of blood creatinine.	**CLO5**

6	Determination of blood sugar.	**CLO5**
7	Determination of serum total cholesterol.	**CLO5**
8	Preparation of buffer solution and measurement of pH.	**CLO2**
9	Study of enzymatic hydrolysis of starch.	**CLO3**
10	Determination of Salivary amylase activity.	**CLO3**
11	Study the effect of Temperature on Salivary amylase activity.	**CLO3**
12	Study the effect of substrate concentration on salivary amylase activity.	**CLO3**

Recommended Books

1. Principles of Biochemistry by Lehninger. 8th edition, 2021.

2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell. 32nd edition, 2022.

3. Biochemistry by Stryer.10th edition, 2023.

4. Biochemistry by D. Satyanarayan and U.Chakrapani, 6th edition, 2021.

5. Textbook of Biochemistry by Rama Rao. 9th edition, 2022.

6. Textbook of Biochemistry by Deb.7 th edition, 2001.

7. Outlines of Biochemistry by Conn and Stumpf . 5th edition, 2006.

8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.6th edition, 2022.

9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition),2017

10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.1983.

11. Practical Biochemistry by Harold Varley. 4th edition, 2005.

PATHOPHYSIOLOGY

COURSE CODE: BP204T

Credits: 04

L-3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the etiology and pathogenesis of the selected disease states
CLO2	Learn the signs and symptoms of the diseases
CLO3	Comprehend the physiology of body systems
CLO4	Recognize the complications of the diseases

Course Content:

UNITS/HOURS	CONTENT	MAPPING
UNIT I **10 HOURS**	• **Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage),Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia),Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance • **Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation,Mechanism of	**CLO1**

	Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, of inflammation,Basic principles of wound healing in the skin,Pathophysiology of Atherosclerosis	
UNIT II **10 HOURS**	•**Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina,myocardial infarction, atherosclerosis and arteriosclerosis) •**Respiratory system:** Asthma, Chronic obstructive airways diseases. •**Renal system:** Acute and chronic renal failure	**CLO3**
UNIT III **10 HOURS**	•**Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia •**Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones •**Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. •**Gastrointestinal system:** Peptic Ulcer	**CLO3, CLO4**
UNIT IV **08 HOURS**	•Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease. •**Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout •**Principles of cancer:** classification, etiology and pathogenesis of cancer	**CLO2, CLO4**

UNIT V **07 HOURS**	•**Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections •**Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	**CLO2, CL04**

Recommended Books

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.

2. Harsh Mohan; Text book of Pathology; 6 th edition; India; Jaypee Publications; 2010.

3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12 th edition; New York; McGraw-Hill; 2011.

4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;

5. William and Wilkins, Baltimore;1991 [1990 printing].

6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.

7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12 th edition; WB Saunders Company; 2010.

8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9 th edition; London; McGraw-Hill Medical; 2014.

9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6 th edition; Philadelphia; WB Saunders Company; 1997.

10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3 rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)

2. The American Journal of Pathology. ISSN: 0002-9440

3. Pathology. 1465-3931 (Online)

4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)

5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

COMPUTER APPLICATIONS IN PHARMACY
COURSE CODE: BP205 T

Credits: 03

L-3	T-0	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand Database, Database Management system, Computer application in clinical studies and use of databases.
CLO2	Practice drug interactions, drug information services and patient counseling and maintain the record
CLO3	Understand that using automated technology can also improve patient care safety by Reducing medication errors, maintaining patient's medication records.
CLO4	Evaluate abnormal changes in patients faster and with more accuracy
CLO5	Design Automated Dispensing Units and Medication Reminder Devices

Course Content:

UNITS/HOURS	CONTENT	MAPPING
UNIT I **06 HOURS**	**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 **Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project	**CLO1, CLO3**

UNIT II **06 HOURS**	**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.	**CLO3, CLO5**
UNIT III **06 HOURS**	**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	**CLO2, CLO4**
UNIT IV **06 HOURS**	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	**CLO4**
UNIT V **06 HOURS**	**Computers as data analysis in Preclinical development:** Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)	**CLO5**

COMPUTER APPLICATIONS IN PHARMACY (PRACTICAL)

COURSE CODE: BP210P

Credits: 01

L-0	T-0	P-2

Course Learning Outcomes:

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

CLO	Statement
CLO1	Know the various types of databases
CLO2	Generate report and printing the report from patient database
CLO3	Design a questionnaire using a word processing package to gather information about a particular disease.
CLO4	Retrieve the information of a drug and its adverse effects using online tools
CLO5	Create and work with MS Excel

Course Content:

PRACTICAL	TITLE	MAPPING
1.	Design a questionnaire using a word processing package to gather information about a particular disease.	**CLO3**
2.	Create a HTML web page to show personal information.	**CLO5**
3.	Retrieve the information of a drug and its adverse effects using online tools	**CLO4**
4.	Creating mailing labels Using Label Wizard , generating label in MS WORD	**CLO5**
5.	Create a database in MS Excel to store the patient information with the required fields Using access	**CLO1**
6.	Design a form in MS Excel to view, add, delete and modify the patient record in the database	**CLO4**

7.	Generating report and printing the report from patient database	**CL02**
8.	Creating invoice table using – MS Excel	**CLO5**
9.	Drug information storage and retrieval using MS Excel	**CLO4,CLO5**
10.	Creating and working with queries in MS Access	**CLO5**

Recommended books:

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.

2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA

3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)

4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

ENVIRONMENTAL SCIENCES

COURSE CODE: BP 206 T

Credits: 03

L-3	T-0	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Generate the awareness about environmental problems in the society
CLO2	Develop an attitude of concern for the environment
CLO3	Attain harmony with Nature.
CLO4	Develop knowledge about ecosystem and natural resources.

Course Content

UNITS/HOURS	CONTENT	MAPPING
UNIT I **10 HOURS**	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.	**CLO1, CLO4**
UNIT II **10 HOURS**	**Ecosystems** Concept of an ecosystem. Structure and function of an ecosystem. Introduction, types, characteristic features, structure and function of the ecosystems:	**CLO2, CLO4**

	Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
UNIT III **10 HOURS**	**Environmental Pollution:** Air pollution; Water pollution; Soil pollution	**CLO1**

Recommended Books :

1. Y.K. Sing, 2006 Environmental Science, New Age International Pvt, Publishers, Bangalore.

2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

3. Bharucha Erach, 2006, The Biodiversity of India, Mapin Pu blishingPvt. Ltd., Ahmedabad – 380 013, India.

4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.

5. Clark R.S.,1986, Marine Pollution, Clanderson Press Oxford.

6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p .

7. De A.K.,2006, Environmental Chemistry, Wiley Eastern Ltd.

8. Down of Earth, Centre for Science and Environment.

Semester- III

PHARMACEUTICAL ORGANIC CHEMISTRY-II

Course code:-BP301T

Credits: 04

L -3	T-1	P-0

Course learning outcomes:

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

CLO	Statement
CLO1	Understandmethodsofpreparationand reactionsoforganiccompounds
CLO2	Applyonheterocycliccompounds
CLO3	AnalyzetheChemistryoffatsandoils
CLO4	Evaluatereactions,reactivity,mechanisms,andorientationoforganiccompounds
CLO5	Createelectrophilicandnucleophilicreactions.

Course Content:

Unit/hours	Contents	Mapping
Unit-I **10 hrs**	•**Benzene and its derivatives** **A**. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule **B.** Reactions of benzene - nitration, sulphonation, halogenationreactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation. **C.** Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction **D.** Structure and uses of DDT, Saccharin, BHC and Chloramine	**CLO1, CLO5, CLO2**
Unit-II **10 hrs**	•**Phenols** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols,	**CLO1, CLO4**

	resorcinol, naphthols •**Aromatic Amines** - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts •**Aromatic Acids** –Acidity, effect of substituents on acidity and important reactions of benzoic acid.	
Unit-III **10 hrs**	•**Fats and Oils** a. Fatty acids – reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	**CLO3**
Unit-IV **08 hrs**	•**Polynuclear hydrocarbons**: a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	**CLO4**
Unit-V **07 hrs**	•**Cyclo alkanes** 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	**CLO4**

PHARMACEUTICAL ORGANIC CHEMISTRY-II (Practical)

Course Code:-BP305P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:
On successful completion of this course, the students will be able to:

CLO	Statement
CLO1	Understand the laboratory techniques for purification and separation.
CLO2	Determine of values for degree of unsaturation.
CLO3	Analyze and prepare compounds
CLO4	Evaluate the reactivity of organic compounds

Course Contents:

Practical	Contents	Mapping
I	Experiments involving laboratory techniques •Recrystallization •Steam distillation	**CLO1, CLO5**
II	Determination of following oil values (including standardization of reagents) •Acid value •Saponification value •Iodine value	**CLO2**
III	**Preparation of compounds** •Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction. •2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ •Acetanilide by halogenation (Bromination) reaction. •5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.	**CLO3, CLO4**

	•Benzoic acid from Benzyl chloride by oxidation reaction. •Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. •1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions. •Benzil from Benzoin by oxidation reaction. •Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction •Cinnammic acid from Benzaldehyde by Perkin reaction •P-Iodo benzoic acid from P-amino benzoic acid	

Recommended Books

1. Organic Chemistry by Morrison and Boyd 7th impression, 2013.
2. Organic Chemistry by I.L. Finar, Volume-I 7th impression, 2009.
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl, 22nd edition, 2017.
4. Organic Chemistry by P.L. Soni, 29th edition, 2012.
5. Practical Organic Chemistry by Mann and Saunders, 4th edition, 2009.
6. Vogel's text book of Practical Organic Chemistry, 5th edition, 2011.
7. Advanced Practical organic chemistry by N.K. Vishnoi. 3rd edition, 2022 (Reprint)
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz, 3rd edition, 2014.

PHYSICAL PHARMACEUTICS-I

Course Code: BP302T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the various physicochemical properties of drug molecules in the designing of dosage forms.
CLO2	Apply the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.
CLO3	Analyze use of physicochemical properties in the formulation development and evaluation of dosage forms.
CLO4	Evaluate the role of surfactants, interfacial phenomenon and thermodynamics.
CLO5	Create physicochemical properties of drug molecules informulation and research development.

Course Content:

Unit/Hours	Contents	Mapping
Unit-I **10 hrs**	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. 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	**CLO1, CLO3**

	applications. Distribution law, its limitations and applications	
Unit-II **10 hrs**	**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. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	**CLO4, CLO5**
Unit-III **08 hrs**	**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.	**CLO4**
Unit-IV **08 hrs**	**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.	**CLO4**
Unit-V **07 hrs**	**pH, buffers and Isotonic solutions:** 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	**CLO2**

PHYSICAL PHARMACEUTICS-I (PRACTICAL)

Course Code:-BP306P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the determination of solubility of drug, pKavalue, Partitionco- efficient, %composition, surfacetension, HLBnumber, Freundlich and Langmuir constants, critical micellar concentration, stability constant and donor acceptor ratio
CLO2	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
CLO3	Analyze the determination of expiry date of formulations.
CLO4	Evaluate the chemical stability tests of various drug products using different methods.

Course Contents:

Practicals	Contents	Mapping
1	Determination the solubility of drug at room temperature	**CLO2, CLO3,CLO4**
2	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation	**CLO1,**
3	Determination of Partition co- efficient of benzoic acid in benzene and water	**CLO1**
4	Determination of Partition co- efficient of Iodine in CCl_4 and water	**CLO1**
5	Determination of % composition of NaCl in a solution using phenol-water system by CST method	**CLO1**

6	Determination of surface tension of given liquids by drop count and drop weight method	**CLO1**
7	Determination of HLB number of a surfactant by saponification method	**CLO1**
8	Determination of Freundlich and Langmuir constants using activated char	**CLO1**
9	Determination of critical micellar concentration of surfactants	**CLO1**
10	Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method	**CLO1, CLO4**
11	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method	**CLO1, CLO4**

Recommended Books:

1. Physical Pharmacy by Alfred Martin 6th edition, 2016.

2. Experimental Pharmaceutics by Eugene, Parott. 4th edition, 1977.

3. Tutorial Pharmacy by Cooper and Gunn, 12th edition, 2008.

4. Stocklosam J. Pharmaceutical Calculations, Lea & Febiger, Philadelphia, 6th edition, 2021.

5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.

6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc. 2nd edition, 1989.

7. Physical Pharmaceutics by Ramasamy C and ManavalanR. Rpt 2024.

8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee, 2nd edition, 2014, Rpt 2019.

9. Physical Pharmaceutics by C.V.S. Subramanyam, 4th edition, 2018.

10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

PHARMACEUTICAL MICROBIOLOGY (Theory)

Course Code:-BP303T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:
On successful completion of this course, the students will be able to:

CLO	Statement
CLO1	Understand methods of identification,cultivation and preservation of various microorganisms
CLO2	Perform sterilization in pharmaceutical process and industry
CLO3	Analyze microbiological standardization of Pharmaceuticals
CLO4	Evaluate sterility testing of pharmaceutical products
CLO5	Develop cell cultures for pharmaceutical industry and research

Course Contents:

Units/ Hours	Contents	Mapping
Unit-I **10 hrs**	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 different types of phaseconstrast microscopy, dark field microscopy and electron microscopy	**CLO1**
Unit-II **10 hrs**	Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical	**CLO3, CLO5**

	gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators.	
Unit-III **10 hrs**	Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. 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.	**CLO2, CLO4**
Unit-IV **08hrs**	Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	**CLO3**
Unit-V **07hrs**	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	**CLO5**

PHARMACEUTICAL MICROBIOLOGY (Practical)

Course Code: BP307P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand Introduction and study of different equipment and processing.
CLO2	Apply importance of microbial limit tests, preservative efficacy test & standardization processes
CLO3	Analyze sterilization status of glassware, culture media
CLO4	Evaluate various structural features, biology & characteristics of microbes
CLO5	Develop new antibiotics and pure cultures of microorganisms for vaccine production

Course Contents:

Practical	Contents	Mapping
1	Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology	**CLO1**
2	Sterilization of glassware, preparation and sterilization of media.	**CLO3**
3	Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations	**CLO3, CLO5**
4	Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).	**CLO2**
5	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.	**CLO4**

6	Microbiological assay of antibiotics by cup plate method and other methods	**CLO4, CLO1**
7	Motility determination by Hanging drop method	**CLO4, CLO1**
8	Sterility testing of pharmaceuticals.	**CLO2, CLO3**
9	Bacteriological analysis of water	**CLO4**
10	Biochemical test	**CLO5**

Recommended Books

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. 9th edition, 2020.

2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2006.

3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. 5th edition, 1993.

4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology, 1964.

5. Rose: Industrial Microbiology, 1961.

6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan

7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher, and Distribution. 12th edition, 2008.

8. Peppler: Microbial Technology. 2nd edition 1979.

9. I.P., B.P., U.S.P.- I.P. – 9th edition, 2022, B.P.- 2024, USP–NF 2023.

10. Ananthnarayan: Text Book of Microbiology, Orient Longman, Chennai, 13th edition, 2022.

11. Edward: Fundamentals of Microbiology. 7th edition

12. N.K. Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi 3rd edition, Rpt 2021.

13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company, 2nd edition, 2011.

PHARMACEUTICAL ENGINEERING

Course code: -BP304T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand various unit operations used in Pharmaceutical industry.
CLO2	Apply various processes involved in pharmaceutical manufacturing.
CLO3	Analyse various tests to prevent environmental pollution.
CLO4	Evaluate appreciate and comprehend significance of plant layout design for optimum use of resources
CLO5	Create the various preventive methods used for corrosion control in pharmaceutical industry

Course Contents:

Units/Hours	Contents	Mapping
Unit-I **10 hrs**	•**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 Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. •**Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses,	**CLO1, CLO2**

	merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	
Unit-II **10 hrs**	•**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. •**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	**CLO2, CLO3**
Unit-III **08 hrs**	•**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 semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers,	**CLO2, CLO3**

	Propellers, Turbines, Paddles & Silverson Emulsifier	
Unit-IV **08 hrs**	•**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 Seidtz filter •**Centrifugation**: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge	**CLO2, CLO3**
Unit-V **07 hrs**	•**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 there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.	**CLO5, CLO4**

Recommended Books:

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, 1st edition, 1955.

2. Solid phase extraction, Principles, techniques, and applications by Nigel J.K. Simpson- 1st edition, 2000.

3. Unit operation of chemical engineering – Mcabe Smith, 7th edition, 2004.

4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., 3rd edition, 2019.

5. Remington practice of pharmacy- Martin, 23rd edition, 2020.

6. Theory and practice of industrial pharmacy by Lachmann., 4th edition, 2020.

7. Physical pharmaceutics- C.V.S Subrahmanyam et al., 4th edition, 2018.

8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, 12th edition, 2008.

PHARMACEUTICAL ENGINEERING (Practical)

Course code:-BP308P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:
On successful completion of this course, the students will be able to:

CLO	Statement
CLO1	Understand the determination of radiation constant, overall heat transfer coefficient, moisture content and loss on drying, humidity of air.
CLO2	Apply Construction working and application of Pharmaceutical Machinery
CLO3	Analyze Size analysis by sieving.
CLO4	Evaluate size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
CLO5	Create steam distillation

Course Contents:

Practical	Contents	Mapping
1	Determination of radiation constant of brass, iron, unpainted and painted g	**CLO1**
2	Steam distillation – To calculate the efficiency of steam distillation	**CLO5**
3	To determine the overall heat transfer coefficient by heat exchanger	**CLO1**
4	Construction of drying curves (for calcium carbonate and starch).	**CLO2**
5	Determination of moisture content and loss on drying.	**CLO1**
6	Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method	**CLO1**

7	Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.	**CLO2**
8	Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plot	**CLO3**
9	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.	**CLO4**
10	Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.	**CLO4**
11	Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity	**CLO5**
12	To study the effect of time on the Rate of Crystallization.	**CLO2**
13	To calculate the uniformity Index for given sample by using Double Cone Blender	**CLO4**

Semester - IV

PHARMACEUTICAL ORGANIC CHEMISTRY–III

CourseCode: BP401T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Stereo-chemical features including conformation and stereo electronic effects; Geometrical isomers
CLO2	Acquire the knowledge and understanding of the basic experimental principles of heterocyclic chemistry.
CLO3	Describe detailed mechanisms for common naming reactions
CLO4	Run experimental techniques, procedures and safe laboratory practices
CLO5	Draw the structures and synthesize simple pharmaceutically active organic compounds having five and six membered heterocyclic compounds

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**Stereo isomerism** Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds, Elements of symmetry, chiral and achiral molecules, DL system of nomenclature of optical isomers, sequence rules, R & S system of nomenclature of optical isomers, Reactions of chiral molecules, Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute	**CLO1**
Unit-2	**Geometrical isomerism**	**CLO1**

10 hrs	Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems), Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions	
Unit-3 **10 hrs**	**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	**CLO2, CLO5**
Unit-4 **8hrs**	**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	**CLO4**
Unit-5 **7hrs**	**Reactions of synthetic importance** Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	**CLO3**

MEDICINAL CHEMISTRY–I

Course Code: BP402T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the basic concepts of medicinal chemistry, its history and development
CLO2	Analyze the structural activity relationship of different class of drugs.
CLO3	Compose the chemical synthesis of some drugs.
CLO4	Evaluate the Structural Activity Relationship (SAR) of different class of drugs.
CLO5	Develop advancements in the Structural Activity Relationship (SAR) of different Class of drugs.

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**Introduction to Medicinal Chemistry,** **History and development of medicinal chemistry,** **Physicochemical properties in relation to biological action** Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. **Drug metabolism** Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.	**CLO1**
Unit-2 **10 hrs**	**Drugs acting on Autonomic Nervous System,** **Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic	**CLO3**

	receptors (Alpha & Beta) and their distribution. **Sympathomimetic agents:** SAR of Sympathomimetic agents Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, 89 Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. • Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. • Agents with mixed mechanism: Ephedrine, Metaramin **Adrenergic Antagonists:** Alpha adrenergic blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.	
Unit-3 **10 hrs**	**Cholinergic neurotransmitters:** Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **Parasympathomimetic agents:** SAR of Parasympathomimetic agents **Direct acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. **Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion. **Cholinesterase reactivator:** Pralidoxime chloride.	**CLO3, CLO2**

	Cholinergic Blocking agents: SAR of cholinolytic agents **Solanaceous alkaloids and analogues:** Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*. **Synthetic cholinergic blocking agents:** Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.	
Unit-4 **8hrs**	**Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics: Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturtes:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital **Miscelleneous:** Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. **B. Antipsychotics Phenothiazeines:** SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazeines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. Fluro buterophenones: Haloperidol, Droperidol, Risperidone. **Beta amino ketones:** Molindone hydrochloride. **Benzamides:** Sulpieride.	**CLO2, CLO4**

	C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action **Barbiturates:** Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin**Oxazolidinediones:** Trimethadione, Paramethadione **Succinimides:**Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas:** Phenacemide, Carbamazepine* **Benzodiazepines:** Clonazepam **Miscellaneous:** Primidone, Valproic acid , Gabapentin, Felbamate	
Unit-5 **7hrs**	**Drugs acting on Central Nervous SystemGeneral anesthetics**: **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short acting barbitutrates:** Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride.* **Narcotic and non-narcotic analgesics Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphantartarate, Naloxone hydrochloride. **Anti-inflammatory agents**: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	CLO5

MEDICINAL CHEMISTRY–I (Practical)

Course Code: BP406P

Credits: 04

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Get well acquainted with the synthesis of some important classes of drugs.
CLO2	Analyze the chemistry of drugs with respect to their pharmacological activity.
CLO3	Evaluate the synthesis of some important classes of drugs.
CLO4	Examine mechanism pathways of different classes of medicinal compounds
CLO5	Develop skills involved in thin layer chromatography techniques and purification of Synthesized compounds by column chromatography

CourseContent

PRACTICAL	TITLE	MAPPING
1	**Preparation of drugs/ intermediates** 1,3-pyrazole, 1,3-oxazole, Benzimidazole, Benztriazole, 2,3- diphenyl quinoxaline, Benzocaine, Phenytoin, Phenothiazine, Barbiturate	**CLO1**
2	**Assay of drugs** Chlorpromazine, Phenobarbitone, Atropine, Ibuprofen, Aspirin, Furosemide	**CLO2, CLO3, CLO4**
3	Determination of Partition coefficient for any two drugs	**CLO5**

Recommended Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry

12th Edition, 2011.
2. Foye's Principles of Medicinal Chemistry 8th Edition, 2019.
3. Burger's Medicinal Chemistry, Vol I to IV, 2021.
4. Introduction to principles of drug design- Smith and Williams 4th Edition, 2014.
5. Remington's Pharmaceutical Sciences 23rd Edition, 2020.
6. Martindale's extra pharmacopoeia 40th Edition 2020.
7. Organic Chemistry by I.L. Finar, Vol. II, 5th Edition.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5, 1997.
9. Indian Pharmacopoeia 9th Edition, 2022.
10. Text book of practical organic chemistry- A.I. Vogel 5th Edition, 2011.

Physical Pharmaceutics-II

Course Code: BP403T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the significance of physicochemical properties of drug molecules, pH and solubility.
CLO2	Determine use of physicochemical properties in the formulation development and Evaluation of dosage forms.
CLO3	Differentiate disperse system in different pharmaceutical preparation.
CLO4	Evaluate half-life.
CLO5	Formulate pure drug substance into a dosage form

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **7hrs**	**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, coacervation, peptization & protective action	**CLO1, CLO2**
Unit-2 **10 hrs**	**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	**CLO2**

	Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus	
Unit-3 **10 hrs**	**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.	**CLO3**
Unit-4 **10hrs**	**Micromeretics:** 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.	**CLO2, CLO4**
Unit-5 **10hrs**	**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	**CLO4**

Physical Pharmaceutics-II (practical)

Course Code: BP 407P

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	State the physicochemical properties of drug molecules, pH, and solubility
CLO2	Explain the role of surfactants, interfacial phenomenon and thermodynamics Describe the flow behavior of fluids and concept of complexation
CLO3	Understand the physical properties of solutions, buffers, isotonicity, disperse systems and rheology and Analyze the chemical stability tests of various drug products
CLO4	Have basic knowledge of pharmaceutical suspensions and colloids
CLO5	Have basic understanding of the pharmaceutical applications and Principles such as lyophilization, aerosols, condensed systems, and phase diagram.

Course Content:

PRACTICAL	TITLE	MAPPING
1	Determination of particle size, particle size distribution using sieving	**CLO1, CLO3**
2	Determination of particle size, particle size distribution using Microscopic method	**CLO3**
3	Determination of bulk density, true density and porosity	**CLO3**
4	Determine the angle of repose and influence of lubricant on angle of repose	**CLO2, CLO5**
5	Determination of viscosity of liquid using Ostwald's viscometer	**CLO4**

6	Determination sedimentation volume with effect of different suspending agent	**CLO4, CLO5**
7	Determination sedimentation volume with effect of different concentration of single suspending agent	
8	Determination of viscosity of semisolid by using Brookfield viscometer	
9	Determination of reaction rate constant first order	
10	Determination of reaction rate constant second order	
11	Accelerated stability studies	

Recommended Books:

1. Physical Pharmacy by Alfred Martin, 6th Edition, 2010.
2. Experimental pharmaceutics by Eugene, Parrott, 4th Edition, 1977.
3. Tutorial pharmacy by Cooper and Gunn, 12th Edition, 2008.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia, 16th Edition, 2021.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekker Inc.,3rd Edition, 2005.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekker Inc., 2nd Edition, 2020.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R., 2017.

Pharmacology-I

Course Code: BP404T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the application of basic pharmacological knowledge in the prevention and treatment of various diseases.
CLO2	Analyze the signal transduction mechanism of various receptors.
CLO3	Explain the mechanism of drug action at organ system /subcellular/ macromolecular levels.
CLO4	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
CLO5	Modify mechanism of action of different drugs

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **8 hrs**	**General Pharmacology** **a.** 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. **b.** Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs	**CLO1, CLO2**

	.Enzyme induction, enzyme inhibition, kinetics of elimination	
Unit-2 **12hrs**	**General Pharmacology** **a.** Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions 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. **b.** Adverse drug reactions. **c.** Drug interactions (pharmacokinetic and pharmacodynamic) **d.** Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	**CLO3**
Unit-3 **10 hrs**	**Pharmacology of drugs acting on peripheral nervous system** **a.** Organization and function of ANS. **b.** Neurohumoral transmission,co-transmission and classification of neurotransmitters. **c.**Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. **d.** Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).	**CLO4, CLO5**

	e. Local anesthetic agents. **f**. Drugs used in myasthenia gravis and glaucoma	
Unit-4 **8hrs**	**Pharmacology of drugs acting on central nervous system** **a.** Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine, **b.** General anesthetics and pre-anesthetics. **c.** Sedatives, hypnotics and centrally acting muscle relaxants. **d.** Anti-epileptics **e.** Alcohols and disulfiram	**CLO4, CLO5**
Unit-5 **7hrs**	**Pharmacology of drugs acting on central nervous system** **a.** Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. **b.** Drugs used in Parkinson's disease and Alzheimer's disease. **c.** CNS stimulants and nootropics. **d.** Opioid analgesics and antagonists **e.** Drug addiction, drug abuse, tolerance and dependence.	**CLO4, CLO5**

Pharmacology-I (practical)

Course Code: BP408P

Credits: 04

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand what drugs do to the living organisms and how their effects can be applied to therapeutics
CLO2	Analyze correlation of pharmacology with other bio medical sciences.
CLO3	Apply laboratory techniques for animal studies
CLO4	Observe the effect of drugs on animals by simulated experiments
CLO5	Invent laboratory techniques for animal studies

Course Content:

PRACTICAL	TITLE	MAPPING
1	Introduction to experimental pharmacology.	**CLO1**
2	Commonly used instruments in experimental pharmacology.	**CLO1, CLO2**
3	Study of common laboratory animals	**CLO4**
4	Maintenance of laboratory animals as per CPCSEA guidelines.	**CLO4**
5	Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.	**CLO3**
6	Study of different routes of drugs administration in mice/rats.	**CLO3, CLO4**

7	Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.	**CLO3**
8	Effect of drugs on ciliary motility of frog oesophagus	**CLO3**
9	Effect of drugs on rabbit eye	**CLO3**
10	Effects of skeletal muscle relaxants using rota-rod apparatus.	**CLO3**
11	Effect of drugs on locomotor activity using actophotometer.	**CLO3**
12	Anticonvulsant effect of drugs by MES and PTZ method	**CLO3**
13	Study of stereotype and anti-catatonic activity of drugs on rats/mice.	**CLO5**
14	Study of anxiolytic activity of drugs using rats/mice.	**CLO5**
15	Study of local anesthetics by different methods	**CLO5**

Recommended Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier, 10th Edition, 2023.

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill, 15th Edition, 2021.

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 14th Edition, 2022.

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, 9th Edition, 2008.

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology, 8th Edition, 2022.

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical

Publishers (P) Ltd, New Delhi, 8th Edition, 2018.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher, 4th Edition, 2023.

8. Modern Pharmacology with clinical Applications, by Charles R. Craig & Robert, 6th Edition, 2003.

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata, 7th Edition, 2019.

10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan, 4th Edition, 2014.

Pharmacognosy and Phytochemistry-I

Course Code: BP405T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the recognition of medicinal plants, their taxonomy, identification of adulteration and Contamination.
CLO2	Analysis of organoleptic microscopic properties of herbal drugs and Apply chemical constituents of drug in commercial pharmaceutical aids
CLO3	Develop plant tissue cultures
CLO4	Understand uses of plant based drugs in different health care system
CLO5	Understand evaluation techniques for the herbal drugs

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**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). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic,	**CLO1**

	microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera	
Unit-2 **10hrs**	**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 **Conservation of medicinal plants**	**CLO1**
Unit-3 **7hrs**	**Plant tissue culture**: Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines	**CLO3**
Unit-4 **10hrs**	**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**.** **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	**CLO4**
Unit-5 **8hrs**	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to	**CLO5**

	chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey **Proteins and Enzymes :**Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids(Waxes, fats, fixed oils)** : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax **Marine Drugs:** Novel medicinal agents from marine sources	

Pharmacognosy and Phytochemistry-I (practical)

Course Code: BP409P

Credits: 04

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Analysis of crude drugs by chemical and microscopic methods
CLO2	Analyze the Material Medicine.
CLO3	Conduct extractions /isolations & explain significance of use of various chemicals & physical conditions.
CLO4	Identify unorganized crude drugs using morphological, chemical, physical & microscopical characteristics.

Course Content:

PRACTICAL	TITLE	MAPPING
1	Analysis of crude drugs by chemical tests: (i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil	**CLO1**
2	Determination of stomatal number and index	**CLO1**
3	Determination of vein islet number, vein islet termination and paliside ratio.	**CLO1**
4	Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer	**CLO1, CLO4**
5	Determination of Fiber length and width	**CLO4**

6	Determination of number of starch grains by Lycopodium spore method	**CLO4**
7	Determination of Ash value	**CLO3, CLO4**
8	Determination of Extractive values of crude drugs	**CLO3**
9	Determination of moisture content of crude drug	**CLO3**
10	Determination of swelling index and	**CLO4**

Recommended Books:

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

2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.

3. Text Book of Pharmacognosy by T.E. Wallis, 5th Edition, 2005.

4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi,2018.

5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae, 37th Edition, Nirali Prakashan, New Delhi, 2007.

6. Herbal drug industry by R.D. Choudhary, IstEdn, Eastern Publisher, New Delhi, 1996.

7. Essentials of Pharmacognosy, Dr.SH.Ansari, 2nd edition, Birla publications, New Delhi, 2007.

8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae, 18th Edition, 2017.

9. Anatomy of Crude Drugs by M.A. Iyengar, 12th Edition, 2018.

SEMESTER –V

MEDICINAL CHEMISTRY– II (Theory)

COURSE CODE - BP501T

Credits: 02

L-3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the classification, mechanism of action and chemical synthesis of various classes of drugs.
CLO2	Comprehend about drug metabolic pathway, adverse effect and therapeutic value of drugs
CLO3	Analyze structural activity relationship of different class of drugs.
CLO4	Evaluate and acquire knowledge about the chemotherapy.
CLO5	To understand the chemistry of drugs with respect to their pharmacological activity.

Course Content:

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 (*)

Units/Hours	Contents	Mapping
Unit I **10Hrs.**	**Antihistaminic agents:** Histamine, receptors and their distribution in the humanbody **H1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidaminetartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium **H2-antagonists:** Cimetidine*, Famotidine, Ranitidin. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole **Anti-neoplastic agents:** **Alkylating agents:** Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plantproducts:** Etoposide, Vinblastinsulphate, Vincristin sulphate Miscellaneous: Cisplatin, Mitotane	**CLO1**
Unit II **10Hrs.**	**Anti-anginal:** **Vasodilators:** Amylnitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.	**CLO1, CLO3**

	Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide Loop diuretics**:** Furosemide*, Bumetanide, Ethacrynicacid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics:Mannitol **Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazinehydrochloride.	
Unit III **10Hrs.**	**Anti-arrhythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemic agents:** Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants:** Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel. **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan**.**	**CLO2, CLO3**
Unit IV **08Hrs.**	**Drugs acting on Endocrine system:** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones:** Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethylstilbestrol. **Drugsfor erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone. **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	**CLO1, CLO2, CLO3**

Unit V **10Hrs.**	**Antidiabetic agents:** Insulin and its preparations Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose,Voglibose **Local Anesthetics:**SAR of Local anesthetics **Benzoic Acid derivatives:** Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **AminoBenzoicacidderivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilidederivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous:** Phenacaine, Diperodon, Dibucaine.*	**CLO4, CLO5**

Recommended Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry, 12th edition, 2010.

2. Foye's Principles of Medicinal Chemistry.7th edition 2012

3. Burger's Medicinal Chemistry, Vol I to IV, 8th edition 2021

4. Introduction to principles of drug design-Smith and Williams, 4th edition 2024

5. Remington's Pharmaceutical Sciences 23rd edition 2020

6. Martindale's extra pharmacopoeia, 31st edition 1996

7. Organic Chemistry by I.L.Finar, Vol.II, 5th edition 2002

8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol.1to 5, 1st edition 1995

9. Indian Pharmacopoeia,9th edition 2022

10. Text book of practical organic chemistry-A.I.Vogel,5th edition 2003

INDUSTRIAL PHARMACY I (Theory)

COURSE CODE: BP502 T

Credits: 04

L-3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Know the various pharmaceutical dosage forms and their manufacturing techniques.
CLO2	Identify various considerations in development of pharmaceutical dosage forms.
CLO3	Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality.
CLO4	Understand the quality control of solid, liquid and semisolid dosage form and cosmetics formulations

Course Content:

Units/Hours	Content	Mapping
Unit I **07Hrs**	**Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. **a. Physical properties:** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism **b. Chemical Properties:** Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and	**CLO1, CLO2**

	parenteral dosage forms and its impact on stability of dosage forms.	
Unit II **10Hrs**	**Tablets:** a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. c.Quality control tests: In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia.	**CLO3**
Unit III **08Hrs**	**Capsules:** a. **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. b. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets.	**CLO3**
Unit IV **10Hrs**	**Parenteral Products:**	**CLO3, CLO4**

	a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity b. Production procedure, production facilities and controls, aseptic processing c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations	
Unit V **10Hrs**	**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **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**.**	**CLO4**

Industrial Pharmacy I (Practical)

COURSE CODE: BP506 P

Credits: 02

L-0	T-0	P-4

Course Outcomes

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

CLO	Statement
CLO1	Know about Development of pharmaceutical dosage form
CLO2	Preparation of solid, liquid and semi-solid dosage forms and evaluate them for their Quality..
CLO3	Understand and appreciate the influence of pharmaceutical additives
CLO4	Quality control test of some dosage forms, study of different type of glasses

Course Content:

PRACTICAL	TITLE	MAPPING
1.	Preformulation studies on paracetamol/asparin/or any other drug	**CLO1**
2.	Preparation and evaluation of Paracetamol tablets	**CLO2**
3.	Preparation and evaluation of Aspirin tablets	**CLO2, CLO4**
4.	Coating of tablets- film coating of tables/granules	**CLO2, CLO3**
5.	Preparation and evaluation of Tetracycline capsules	**CLO2**
6.	Preparation of Calcium Gluconate injection	**CLO2**
7.	Preparation of Ascorbic Acid injection	**CLO2**
8.	Qulaity control test of (as per IP) marketed tablets and capsules	**CLO4**

9.	Preparation of Eye drops/ and Eye ointments	**CLO2**
10.	Preparation of Creams (cold/vanishing cream)	**CLO2**
11.	Evaluation of Glass containers (as per IP)	**CLO4**

Recommended Books:

1. Pharmaceutical dosage forms- Tablets, volume 1-3 by H.A. Liberman, Leon Lachman & J.B.Schwartz,2nd edition 1989

2. Pharmaceutical dosage form- Parenteral medication vol- 1&2 by Liberman & Lachman 2nd edition 1992

3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman,2nd edition 1996

4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 4th Edition 2002

5. Remington: The Science and Practice of Pharmacy, 23rd edition 2021 Pharmaceutical Science (RPS)

6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman 4th edition 2022

7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition 8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea & Febiger, Philadelphia, 5thedition, 2005

9. Drug stability- Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition 2000, Marcel Dekker Series, Vol 107

PHARMACOLOGY-II (Theory)

COURSE CODE: BP503T

Credits: 04

L-3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the effect of drugs on physiological system.
CLO2	Acquire the knowledge of newer targets of several disease conditions for treatment.
CLO3	Appreciate correlation of pharmacology with related medical sciences.
CLO4	Understand the Assumption the mechanism of drug action and its relevance in the treatment of different diseases.

Course Content:

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	**1. Pharmacology of drugs acting on cardio vascular 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.	**CLO1**
Unit II **10Hrs**	**1. Pharmacology of drugs acting on cardio vascular system** a. Drug used in the therapy of shock. b. Hematinics, coagulants and anticoagulants.	**CLO1, CLO2**

	c. Fibrinolytics and anti-platelet drugs d. Plasma volume expanders **2. Pharmacology of drugs acting on urinary system** a. Diuretics b. Anti-diuretics.	
Unit III **10Hrs**	**Autocoids and related drugs** a. Introduction to autacoids 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. Antirheumatic drugs	**CLO3**
Unit IV **08Hrs**	**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	**CLO4**

Unit V **07Hrs**	**Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. **Bioassay** a. Principles and applications of bioassay. b.Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT.	**CLO4**

PHARMACOLOGY-II (Practical)

COURSE CODE: BP507P

Credits: 02

L-0	T-0	P-4

Course Outcomes:

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

CLO	Statement
CLO1	Demonstrate the various receptor actions using isolated tissue preparation.
CLO2	Establish isolation of different organs/tissues from the laboratory animals by Simulated experiments
CLO3	Perform various *in-vitro* experiments to demonstrate receptor action
CLO4	Appreciate the correlation of pharmacology with related medical sciences

Course Content:

PRACTICAL	TITLE	MAPPING
1.	Introduction to *in-vitro* pharmacology and physiological salt solutions	**CLO3**
2.	Effect of drugs on isolated frog heart.	**CLO2**
3.	Effect of drugs on blood pressure and heart rate of dog.	**CLO2**
4.	Study of diuretic activity of drugs using rats/mice.	**CLO1, CLO2**
5.	DRC of acetylcholine using frog rectus abdominis muscle.	**CLO2**
6.	Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.	**CLO2**
7.	Bioassay of histamine using guinea pig ileum by matching method.	**CLO2**
8.	Bioassay of oxytocin using rat uterine horn by interpolation method.	**CLO2**

9.	Bioassay of serotonin using rat fundus strip by three point bioassay.	**CLO2**
10.	Bioassay of acetylcholine using rat ileum/colon by four point bioassay.	**CLO2**
11.	Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).	**CLO2**
12.	Determination of PD2 value using guinea pig ileum.	**CLO2**
13.	Effect of spasmogens and spasmolytics using rabbit jejunum.	**CLO2**
14.	Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.	**CLO4**
15.	Analgesic activity of drug using central and peripheral methods	**CLO4**

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

Recommended Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier 10th edition 2023

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill. 15th edition 2008

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics 14th edition 2023

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 9th edition 2008

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews Pharmacology 8th edition 2022

6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi, 8th edition 2018

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher 4th edition 2023

8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert. 6th edition 2003

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata 6th edition 2008

10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan, 4th edition 2022

PHAMACOGNOSY AND PHYTOCHEMISTRY II

COURSE CODE: BP504T

Credits: 02

L-3	T-1	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand the metabolic pathways of secondary metabolite
CLO2	Carry-out isolation and identification of phytoconstituents
CLO3	Evaluate the herbal formulation for safety and stability
CLO4	Perform estimation and characterization of phytoconstituents
CLO5	Explore the modern extraction techniques

Course Content:

UNITS/HOURS	CONTENTS	MAPPING
Unit I **07Hrs**	**Metabolic pathways in higher plants and their determination** a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.	**CLO1, CLO3**
Unit II **14Hrs**	General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:	**CLO2, CLO3**

	Alkaloids: Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta Steroids, Cardiac Glycosides & **Triterpenoids:**Liquorice, Dioscorea, **Digitalis Volatile oils:** Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides:** Senna, Aloes, Bitter Almond **Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids	
Unit III **06Hrs**	Isolation, Identification and Analysis of Phytoconstituents **a) Terpenoids:** Menthol, Citral, Artemisin **b) Glycosides:**Glycyrhetinic acid & Rutin **c) Alkaloids:** Atropine, Quinine, Reserpine, Caffeine **d) Resins:** Podophyllotoxin, Curcumin	**CLO3, CLO4**
Unit IV **10Hrs**	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	**CLO4**
Unit V **08Hrs**	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs	**CLO4, CLO5**

PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

COURSE CODE: BP508P

Credits: 02

L-0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the preparation and development of herbal formulation.
CLO2	Apply isolation and identification of phytoconstituents
CLO3	Analyze the identification of phytoconstituents
CLO4	Evaluate the development of herbal formulation.
CLO5	Find out the separationofsugarsbypaperchromatography

Course Content:

PRACTICAL	TITLE	MAPPING
1.	Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander	**CLO1, CLO3**
2.	Exercise involving isolation & detection of active principles a. Caffeine- from tea dust. b. Diosgenin from Dioscorea c. Atropine from Belladonna d. Sennosides from Senna	**CLO2, CLO3**
3.	Separation of sugars by Paper chromatography	**CLO5**
4.	TLC of herbal extract	**CLO5**
5.	Distillation of volatile oils and detection of phytoconstitutents by TLC	**CLO4, CLO5**

6.	Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh	**CLO2, CLO4**

Recommended Books:

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

2. MohammadAli. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi, 1st edition 2018

3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhla, 54th edition 2019 Nirali Prakashan, New Delhi.

4. Herbal drug industry by R.D. Choudhary(1996), Ist Edn, Eastern Publisher, New Delhi.

5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2016

6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi,3rd edition 2015

7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, revised edition 14th 2023

8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.

9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor. 1996

10. The formulation and preparation of cosmetic, fragrances and flavours, 2nd edition 1994

11. Remington's Pharmaceutical sciences, 23rd edition 2023

12. Text Book of Biotechnology by Vyas and Dixit, 2007

13. Text Book of Biotechnology by R.C. Dubey,5th edition 2014

PHARMACEUTICAL JURISPRUDENCE (Theory)

COURSE CODE: BP505T

Credits: 02

L-3	T-1	P-0

Course Outcomes:
On successful completion of this course, the students will be able to:

CLO	Statement
CLO1	Understand the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.
CLO2	Apply Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals, Create detailed study of Schedules
CLO3	Analyze the code of ethics during the pharmaceutical practice.
CLO4	Evaluate the basic knowledge on important legislations related to the profession of Pharmacy in India

Course Content:

UNITS/HOURS	CONTENTS	MAPPING
Unit I **10Hrs**	**Drugs and Cosmetics Act, 1940 and its rules 1945:** Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs– Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs– Prohibition of manufacture and sale of certain drugs 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 repacking license	**CLO1**

Units II **10Hrs**	Drugs and Cosmetics Act, 1940 and its rules 1945. Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs– Wholesale, Retail sale and Restricted license. Offences and penalties Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. 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	**CLO1, CLO2**
Units III **10Hrs**	**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. **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. **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 13cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties.	**CLO2**
Unit IV **08Hrs**	**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 **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics	**CLO2, CLO3**

	Committee, CPCSEA guidelines for 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 **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)	
Unit V **07 Hrs**	•**Pharmaceutical Legislations**– A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee •**Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath •**Medical Termination of Pregnancy Act** •**Right to Information Act** •**Introduction to Intellectual Property Rights (IPR)**	**CLO3, CLO4**

Recommended books

1. Forensic Pharmacy by B. Suresh,2010
2. Text book of Forensic Pharmacy by B.M. Mithal,2011
3. Hand book of drug law-by M.L. Mehra 9th edition 1997
4. A text book of Forensic Pharmacy by N.K. Jain 2017
5. Drugs and Cosmetics Act/Rules by Govt. of India publications 2008
6. Medicinal and Toilet 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 by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

MEDICINALCHEMISTRY –III

Course Code: BP601T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:
On successful completion of this course, the students will be able to

CLO	Statement
CLO1	Understand the basics of chemotherapy, use of antibiotics and other chemotherapeutic agents
CLO2	Assume drug metabolism, bioavailability and pharmacokinetics.
CLO3	Analyze the result of drug designing and relationship of SAR.
CLO4	Evaluate the relationship between structure and biological activity of drug.
CLO5	Understand the importance of drug design and different techniques of drug design Discover and design the drug with modern techniques.

Course Contents:

Unit/hours	Contents	Mapping
Unit I **10 hrs**	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **β-Lactam antibiotics**: Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin **Tetracyclines:**Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline	**CLO1, CLO2, CLO3**
Unit II **10 hrs**	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important	**CLO1, CLO2, CLO3**

	products of the following classes. 126 **Macrolide**: Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin **Prodrugs**: Basic concepts and application of prodrugs design. **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, Artesunete, Artemether, Atovoquone	
Unit III **10 hrs**	**Anti-tubercular Agents Synthetic anti tubercular agents**: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti tubercular antibiotics**: Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate. **Urinary tract anti-infective agents** **Quinolones:** SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:**Furazolidine, Nitrofurantoin*, Methanamine. **Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.	**CLO1, CLO2, CLO3**
Unit IV **10 hrs**	**Antifungal agents:** **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin.	**CLO3, CLO4**

	Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate***.** **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:**Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. **Sulphonamides and Sulfones** Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones:** Dapsone*.	
Unit V **10 hrs**	**Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. **Combinatorial Chemistry**: Concept and applications chemistry: solid phase and solution phase synthesis.	**CLO5**

MEDICINAL CHEMISTRY-III Lab

Course Code: BP607P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the structure, chemistry and therapeutic value of drugs
CLO2	To perform synthesis and study SAR of drug.
CLO3	Analyze the chemistry of drug.
CLO4	Evaluate the relationship between structure and biological activity of various drug molecules.
CLO5	Create the structure and physical properties of drugs to their pharmacological activity.

Course Contents:

Practicals	Contents	Mapping
I	1. Sulphanilamide 2. 7-Hydroxy, 4-methyl coumarin 3. Chlorobutanol 4. Triphenyl imidazole 5. Tolbutamide 6. Hexamine	**CLO1, CLO2**
II	1. Isonicotinic acid hydrazide 2. Chloroquine	**CLO1, CLO2**

	3. Metronidazole 4. Dapsone 5. Chlorpheniramine maleate 6. Benzyl penicillin	
III	Preparation of medicinally important compounds or intermediates by Microwave irradiation technique	**CLO1**
IV	Drawing structures and reactions using chem draw®	**CLO4**
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 (Lipinskies RO5)	**CLO4, CLO5**

Recommended Books

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry, 12th edition, 2010.

2. Foye's Principles of Medicinal Chemistry, 7th edition, 2012.

3. Burger's Medicinal Chemistry, Vol I to IV, 8th edition 2021.

4. Introduction to principles of drug design- Smith and Williams, 4th edition 2024.

5. Remington's Pharmaceutical Sciences, 23rd edition, 2020.

6. Martindale's extra pharmacopoeia, 31st edition 1996.

7. Organic Chemistry by I.L. Finar, Vol. II, 5th edition 2002.

8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5, 1st edition 1995.

9. Indian Pharmacopoeia, 9th edition 2022.

10. Text book of practical organic chemistry- A.I.Vogel, 5th edtion 2003.

PHARMACOLOGY-III
CourseCode:BP602T

L -3	T-1	P-0

Credits: 04

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the pharmacological activity of drug.
CLO2	Apply their knowledge on chemotherapy of different disease.
CLO3	Analyze the result of drug designing and relationship of SAR.
CLO4	Evaluate the relationship between structure and biological activity of drug.
CLO5	Study toxicity effect

Course Contents:

Units/hours	Contents	Mapping
Units I **10 hrs**	**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 **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	**CLO1**

Units II **10 hrs**	**3. Chemotherapy** a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides	**CLO2**
Units III **10 hrs**	a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e. Anthelmintics f. Antimalarial drugs g. Antiamoebic agents	**CLO2**
Units IV **08 hrs**	Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy. **4. Immunopharmacology** a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	**CLO3, CLO4**
Units V **07 hrs**	**5. Principles of toxicology** a. Definition and basic knowledge of acute, subacute and chronic toxicity. b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning d. Clinical symptoms and management of barbiturates, morphine, organo-	**CLO4**

	phosphosphorus compound and lead, mercury and arsenic poisoning. 6. **Chronopharmacology** a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy	

PHARMACOLOGY-III lab

Course Code: BP608P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the various Biostatistics methods in experimental pharmacology.
CLO2	Handle the animals to administer drugs into animal and record drug response.
CLO3	Analyze various *in-vitro* experiments to demonstrate receptor action using isolated tissue preparation.
CLO4	Evaluate the toxic effects of drugs.
CLO5	Create record report of drugs therapeutic effects.

Course Contents:

Practicals	Contents	Mapping
1	Dose calculation in pharmacological experiments	**CLO1**
2	Antiallergic activity by mast cell stabilization assay	**CLO3**
3	Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model	**CLO2, CLO3**
4	Study of effect of drugs on gastrointestinal motility	**CLO2, CLO5**
5	Effect of agonist and antagonists on guinea pig ileum	**CLO2, CLO3**

6	Estimation of serum biochemical parameters by using a semi-autoanalyzer	**CLO3, CLO5**
7	Effect of saline purgative on frog intestine	**CLO2, CLO3**
8	Insulin hypoglycemic effect in rabbit	**CLO2, CLO3**
9	Test for pyrogens (rabbit method)	**CLO3**
10	Determination of acute oral toxicity (LD50) of a drug from a given data	**CLO4**
11	Determination of acute skin irritation/corrosion of a test substance	**CLO2, CLO3, CLO4**
12	Determination of acute eye irritation/corrosion of a test substance	**CLO3**
13	Calculation of pharmacokinetic parameters from a given data	**CLO1**
14	Biostatistics methods in experimental pharmacology(student's t test, ANOVA)	**CLO1**
15	Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)	**CLO1**

Recommended Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier, 10th edition 2023.

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill, 15th edition 2008.

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics, 14th edition 2023.

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, 9th edition 2008.

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology, 8th edition 2022.

6. K.D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi, 8th edition 2018.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher, 4th edition 2023.

8. Modern Pharmacology with clinical Applications, by Charles R. Craig& Robert, 6th edition 2003.

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata, 6th edition 2008.

10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan, 4th edition 2022.

11. N. Udupa and P.D. Gupta, Concepts in Chronopharmacology, 2009.

Herbal Drug Technology

Course code: BP603T

Credit: 4

L -3	T-1	P-0

CLO	Statement
CLO1	Understand the raw material as source of herbal drugs from cultivation to herbal drug product.
CLO2	Apply their ideas on the WHO and ICH guidelines for evaluation of herbal drugs.
CLO3	Analyze the behavior herbal cosmetics, natural sweeteners, nutraceuticals.
CLO4	Evaluate WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.
CLO5	Follow the ideas on GMP GUIDELINES.

Course Contents:

Units/hours	Contents	Mapping
Units I **11 hrs**	**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 **Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. **Indian Systems of Medicine** 14 a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma	**CLO1**
Units II	**Nutraceuticals** General aspects, Market, growth, scope and types of products available in the market.	**CLO1**

07 hrs	Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina **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	
Units III **10 hrs**	**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. **Herbal Excipients:** Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations**: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes	**CLO1**
Units IV **10 hrs**	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products**: a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.	**CLO2, CLO3**

	Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	
Units V **07 hrs**	**General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. **Schedule T– Good Manufacturing Practice of Indian systems of medicine** Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.	**CLO3, CLO4, CLO5**

HERBAL DRUG TECHNOLOGY Lab
Course Code: BP609 P

Credits: 02

L -0	T-0	P-4

Course Learning Outcomes:

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

CLO	Statement
CLO1	Evaluate the presence of phytoconstituents in crude drugs using phytochemical screening.
CLO2	Evaluation of herbal formulation and ingredients.
CLO3	Create herbal formulations like syrups, mixtures and tablets and Novel dosage Analyze.
CLO4	Evaluate toxicological aspects of active ingredients and finished products, WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.

Course Contents:

Practicals	Contents	Mapping
1	To perform preliminary phytochemical screening of crude drugs.	**CLO1**
2	Determination of the alcohol content of Asava and Aris	**CLO2**
3	Evaluation of excipients of natural origin	**CLO2**
4	Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements	**CLO2, CLO3**
6	Monograph analysis of herbal drugs from recent Pharmacopoeias	**CLO4**
7	Determination of Aldehyde content	**CLO1**
8	Determination of Phenol content	**CLO2**

9	Determination of total alkaloids	**CLO1**

Recommended Books:

1. Textbook of Pharmacognosy by Trease & Evans, 16th edition 2009.

2. Textbook of Pharmacognosy by Tyler, Brady & Robber, 7th edition 1977.

3. Pharmacognosy by Kokate, Purohit and Gokhale, 2nd edition 2017.

4. Essential of Pharmacognosy by Dr.S.H. Ansari, 1st edition 2016.

5. Pharmacognosy & Phytochemistry by V.D. Rangari, 2nd edition 2017.

6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy), revised edition 2008.

7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002, Reprint edition 2012

BIOPHARMACEUTICS AND PHARMACOKINETICS

Course Code: BP 604 T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:
On successful completion of this course, the students will be able to

CLO	Statement
CLO1	Analyze the principles of pharmacokinetics that underline the absorption, distribution, metabolism and elimination of drug.
CLO2	Apply the concept of metabolism, elimination, bioavailability and bioequivalence.
CLO3	Understand the concepts of pharmacokinetics through different compartment model
CLO4	Evaluate the effect of physiological factor and variability of pharmacokinetics parameters towards drug deposition within body.
CLO5	Understand the various causes of non-linear pharmacokinetics.

Course Contents:

Units/hours	Contents	Mapping
Units I **10 hrs**	**Introduction to Biopharmaceutics** **Absorption**; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding	**CLO1**
Units II **10 hrs**	**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs	**CLO2**

	Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	
Units III **10 hrs**	**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE ,t1/2,Vd,AUC,Ka, Clt and CLR-definitions methods of eliminations, understanding of their significance and application	**CLO3**
Units IV **08 hrs**	**Multicompartment models:** Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settins	**CLO4**
Units V **07 hrs**	**Nonlinear Pharmacokinetics**: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs	**CLO5**

Recommended Books:

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi, 4th edition 2005.

2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari, 4th edition 1986.

3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall Inernational edition, USA, 7th edition 2016.

4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B. Jaiswal, VallabhPrakashan Pitampura, Delhi, new edition 2019.

5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc., 2nd edition 1982.

6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press, 4th edition 2005.

7. Biopharmaceutics; By Swarbrick, 1971.

8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and T. N. Tozer, 3rd edition 1995.

9. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania, 1989.

10. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 4th edition,1987.

11. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia, 16th edition 1980.

PHARMACEUTICAL BIOTECHNOLOGY

Course Code: BP605T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the terms and concepts of biotechnology with reference to its application in Pharmacy.
CLO2	Comprehend the technique of genetic engineering and its applications
CLO3	Explain the concept like blotting techniques, application of monoclonal antibody technology and other important methodologies required in industries
CLO4	Appreciate the use of microorganisms in fermentation technology

Course Contents:

Units/hrs	Contents	Mapping
Units I **10 Hrs**	a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. b) Enzyme Biotechnology- Methods of enzyme immobilization and applications. c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries. d) Brief introduction to Protein Engineering. e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. f) Basic principles of genetic engineering	**CLO1**
Units II	a) Study of cloning vectors, restriction endonucleases and DNA ligase.	**CLO2**

10 Hrs	b) Recombinant DNA technology. Application of genetic engineering in medicine. c) Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones- Insulin. d) Brief introduction to PCR	
Units III **10 Hrs**	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 Substituties.	**CLO3, CLO4**
Units IV **8Hrs**	a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting. b) Genetic organization of Eukaryotes and Prokaryotes c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. d) Introduction to Microbial biotransformation and applications. e) Mutation: Types of mutation/mutants.	**CLO4**
Units V **7 Hrs**	a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.	**CLO5**

	b) Large scale production fermenter design and its various controls. c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.	

Recommended Books

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C., 3rd edition 2002.

2. RA Goldshy et. al., Kuby Immunology, 8th edition 2018.

3. J.W. Goding: Monoclonal Antibodies, 3rd edition 1996.

4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry, 4th edition 2000.

5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio, 1973.

6. S.B. Primrose: Molecular Biotechnology Blackwell Scientific Publication, 2nd edition 1991.

7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, Aditya books Ltd., New Delhi, 3rd edition 2016

PHARMACEUTICAL QUALITY ASSURANCE
Course Code: BP606

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the responsibilities of QA & QC departments, cGMP aspects in a pharmaceutical industry
CLO2	Apply GMP overviews of ICH guidelines.
CLO3	Analyze the scope of quality certifications applicable to pharmaceutical industries
CLO4	Evaluate the basic fundamental of quality concepts.
CLO5	Acquire a thorough understanding of important QC, QA.

Course Contents:

Units/hours	Contents	Mapping
Units I **10 hrs**	**Quality Assurance and Quality Management concepts**: Definition and concept of Quality control, Quality assurance and GMP **Total Quality Management (TQM):** Definition, elements, philosophies **ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines **Quality by design (QbD):** Definition, overview, elements of QbD program, tools **ISO 9000 & ISO14000:** Overview, Benefits, Elements, steps for registration	**CLO1**

	NABL accreditation : Principles and procedures	
Units II **10 hrs**	**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. **Equipments and raw materials**: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials	**CLO2**
Units III **10 hrs**	**Quality Control:** Quality control test for containers, rubber closures and secondary packing 141 materials. **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	**CLO2**
Units IV **08 hrs**	**Complaints**: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Document maintenance in pharmaceutical industry**: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	**CLO3**
Units V **07 hrs**	**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. **Warehousing**: Good warehousing practice, materials management	**CLO4, CLO5**

Recommended Books:

1. Quality Assurance Guide by organization of Pharmaceutical Products of India, 1998.

2. Good Laboratory Practice Regulations, Sandy Weinberg Vol. 69, 4th edition 2007.

3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications, 1998.

4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh.

5. How to Practice GMP's – P P Sharma, 7th edition.

6. ISO 9000 and Total Quality Management – Sadhank G Ghosh, edition 2018.

7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms, 3rd edition, 1995.

8. Good laboratory Practices – Marcel Deckker Series, edition 1989.

9. ICH guidelines, ISO 9000 and 14000 guidelines, 1987, 1996.

INSTRUMENTAL METHODS OF ANALYSIS

Course Code: BP701T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO 1	Appreciate the interaction of matter with electromagnetic radiations and its applications in drug analysis.
CLO 2	Comprehend the various spectroscopic techniques and chromatographic separation for the analysis of drugs
CLO 3	Understand quantitative & qualitative analysis of drugs using various analytical instruments
CLO 4	Learn documentation and express the observations with clarity.

Course Content:

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**UV Visible spectroscopy:** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis **Fluorimetry:** Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications	**CLO1**
Unit-2 **10 hrs**	**IR spectroscopy:** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation,	**CLO2**

	wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications **Flame Photometry-**Principle, interferences, instrumentation and applications 144 **Atomic absorption spectroscopy-** Principle, interferences, instrumentation and applications **Nepheloturbidometry**- Principle, instrumentation and applications	
Unit-3 **10 hrs**	**Introduction to chromatography** **Adsorption and partition column chromatography-**Methodology, advantages, disadvantages and applications. **Thin layer chromatography-** Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. **Paper chromatography-**Introduction, methodology, development techniques, advantages, disadvantages and applications **Electrophoresis–** Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications	**CLO3**
Unit-4 **8hrs**	**Gas chromatography-** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications **High performance liquid chromatography (HPLC)-**Introduction, theory, instrumentation, advantages and application	**CLO3, CLO4**
Unit-5 **7hrs**	**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications **Gel chromatography-** Introduction, theory, instrumentation and applications	**CLO3, CLO4**

	Affinity chromatography- Introduction, theory, instrumentation and applications	

Recommended Books

1. Instrumental Methods of Chemical Analysis by B.K Sharma, 24th Ed., 2006.

2. Organic spectroscopy by Y.R Sharma,5th Ed., 2013.

3. Text book of Pharmaceutical Analysis by Kenneth A. Connors, 3rd Ed., 2007.

4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel, 6th Ed., 2009.

5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake, 4th Ed., 2005.

6. Organic Chemistry by I. L. Finar, 9th Ed., 2015.

7. Organic spectroscopy by William Kemp, 3rd Ed., 2002.

8. Quantitative Analysis of Drugs by D. C. Garrett, 3rd Ed., 2008.

9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P.D. Sethi, 3rd Ed., 2019.

10. Spectrophotometric identification of Organic Compounds by Silverstein, 8th Ed., 2014.

INSTRUMENTAL METHODS OF ANALYSIS (Practical)

Course Code: BP705P

L -0	T-0	P-4

Credits: 02

Course Learning Outcomes:

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

CLO	Statement
CLO1	Prepare accurate analysis and report the results in defined formats.
CLO2	Develop practical skills for the analysis of drugs and excipients using various Instrumentation techniques.
CLO3	Perform quantitative and qualitative analysis of drugs using various analytical methods
CLO4	Understand the chromatographic separation and analysis of drugs.

Course Content:

PRACTICAL	TITLE	MAPPING
1	Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds	**CLO1**
2	Estimation of dextrose by colorimetry	**CLO1, CLO2**
3	Estimation of sulfanilamide by colorimetry	**CLO3**
4	Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy	**CLO3**
5	Assay of paracetamol by UV-Spectrophotometry	**CLO3**
6	Estimation of quinine sulfate by fluorimetry	**CLO3**
7	Study of quenching of fluorescence	**CLO1, CLO3**
8	Determination of sodium by flame photometry	**CLO3**

9	Determination of potassium by flame photometry	**CLO3**
10	Determination of chlorides and sulphates by nephelo turbidometry	**CLO3**
11	Separation of amino acids by paper chromatography	**CLO4**
12	Separation of sugars by thin layer chromatography	**CLO4**
13	Separation of plant pigments by column chromatography	**CLO4**
14	Demonstration experiment on HPLC	**CLO4**
15	Demonstration experiment on Gas Chromatography	**CLO4**

INDUSTRIAL PHARMACY II

Course Code: BP 702 T

L -3	T-1	P-0

Credits: 04

Course Learning Outcomes:

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

CLO	Statement
CLO1	Know the process of pilot plant and scale up of pharmaceutical dosage forms.
CLO2	Understand the process of technology transfer from lab scale to commercial batch.
CLO3	Recognize different Laws and Acts that regulate pharmaceutical industry
CLO4	Comprehend the approval process and regulatory requirements for drug products.
CLO5	Recognize different Laws and Acts that regulate pharmaceutical industry

Course Content

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**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	**CLO1**
Unit-2 **10 hrs**	**Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation,	**CLO2**

	Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India- APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues	
Unit-3 **10 hrs**	**Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals **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.	**CLO3**
Unit-4 **8hrs**	**Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP	**CLO4**
Unit-5 **7hrs**	**Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drug	**CLO5**

Recommended Books:

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.

2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php

3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics'2nd Edition.2014

4. Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

PHARMACY PRACTICE

Course Code: BP703T

Credits: 04

L -3	T-1	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand drug distribution methods in hospital and apply it in the practice of pharmacy.
CLO2	Apply and Interpret role of pharmacist in education and training program.
CLO3	Analyze requirements essential for hospital, community and hospital pharmacy management.
CLO4	Evaluate medication history, medication adherence and adverse effects of drugs
CLO5	Develop clinical report, adverse reaction report of patients

Course Content

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**a) Hospital and it's 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 staffs involved in the hospital and their functions**.** **b) Hospital pharmacy and its organization:** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **c) Adverse drug reaction Classifications -** Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity,	**CLO1, CLO4**

	toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. **d) 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	
Unit-2 **10 hrs**	**a) 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. **b) 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**.** **c) Therapeutic drug monitoring**: Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **d) Medication adherence**:Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. **e) Patient medication history interview:** Need for the patient medication history interview, medication interview forms. **f) Community pharmacy management:** Financial, materials, staff, and infrastructure requirements.	**CLO2**

Unit-3 **10 hrs**	**a) Pharmacy and therapeutic committee** Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. **b) Drug information services:** Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. **c) Patient counseling:**Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist **d) 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. **e) Prescribed medication order and communication skills:** Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and	**CLO3, CLO4**
Unit-4 **8hrs**	**a) Budget preparation and implementation:** Budget preparation and implementation **b) 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. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern**.**	**CLO4**

	c) Over the counter (OTC) sales: Introduction and sale of over the counter, and Rational use of common over the counter medications.	
Unit-5 **7hrs**	**a) 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 **b) Investigational use of drugs**: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. **c) Interpretation of Clinical Laboratory Tests:** Blood chemistry, hematology, and urinalysis	**CLO4, CLO5**

Recommended Books:

1. Merchant S.H. and Dr. J.S.Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.

2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice- essential concepts and skills, 1 st ed. Chennai: Orient Longman Private Limited; 2004.

3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea &Febiger; 1986.

4. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.

5. Scott LT. Basic skills in interpreting laboratory data, 4thed. American Society of Health System Pharmacists Inc; 2009.

6. Parmar N.S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers & Distributers; 2008.

NOVEL DRUG DELIVERY SYSTEMS

Course Code: BP 704T

Credits: 04 | **L -3 T-1 P-0**

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand various properties of sustained and controlled drug delivery systems.
CLO2	Apply formulation and evaluation of various controlled drug delivery system for Oral and parenteral.
CLO3	Analyze design of a drug delivery system.
CLO4	Evaluate current development in drug delivery system.
CLO5	Create selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation.

Course Content

UNIT/HOURS	CONTENT	MAPPING
Unit-1 **10 hrs**	**Controlled drug delivery systems:** Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates.Approaches to design controlled release formulations based on diffusion, dissolution and ion 17exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.	**CLO1**

Unit-2 **10 hrs**	**Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications **Mucosal Drug Delivery system:** Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems **Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump	**CLO2**
Unit-3 **10 hrs**	**Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches **Gastroretentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers	**CLO2, CLO3**
Unit-4 **8hrs**	**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications	**CLO4, CLO5**
Unit-5 **7hrs**	**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome – Preliminary study, ocular formulations and ocuserts **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages,	**CLO4, CLO5**

	development of intra uterine devices (IUDs) and applications	

Recommended Books:

1. Y W. Chien, Novel Drug Delivery Systems, 2 nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim

4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

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SEMESTER VIII

BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)

COURSE CODE: BP801T

Credits: 04

L-3	T-1	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Know the various statistical methods to solve different types of problems, analyze distinguish the application of statistical in clinical data management.
CLO2	Apply design of Experiments, Experiential Design Technique, plagiarism, Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph
CLO3	Operate various statistical software packages, Understand about operation of M.S.Excel, SPSS, R and MINITAB, DoE (Design of Experiment
CLO4	Evaluate the 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
CLO5	Create the appreciate statistical techniques in solving the problems

COURSE CONTENT

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	**Introduction:** Statistics, Biostatistics, Frequency **distribution Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion:** Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation Pharmaceuticals examples	**CLO1**
Unit II **10Hrs**	**Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a+by,	**CLO1, CLO2**

	Multiple regression, standard error of regression– Pharmaceutical Examples **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 **Parametric test**: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference	
Unit III **10 Hrs**	**Non Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism **Graphs:** Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **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.	**CLO2, CLO3**
Unit IV **08Hrs**	Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regression models **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	**CLO3, CLO4**

Unit V **07Hrs**	**Design and Analysis of experiments:** **Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design **Response Surface methodology:** Central composite design, Historical design, Optimization Techniques	**CLO4, CLO5**

Recommended Books

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork. 1st edtion 1997

2. Fundamental of Statistics– Himalaya Publishing House- S.C.Guptha 8th edtion 2018

3. Design and Analysis of Experiments–PHI Learning Private Limited, R. Pannerselvam, 2012

4. Design and Analysis of Experiments– Wiley Students Edition, Douglas and C. Montgomer 10th edition 2019

SOCIAL AND PREVENTIVE PHARMACY

COURSE CODE: BP802T

Credits: 04

L-3	T-1	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
CLO2	Apply a critical way of thinking based on current health care development
CLO3	Analyze improvement in rural sanitation, national urban health mission, Health promotion and education in school
CLO4	Evaluate alternative ways of solving problems related to health and pharmaceutical issues.
CLO5	Create a better health care service system.

Course Content:

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	**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. **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. **Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health **Hygiene and health:** personal hygiene and health care; avoidable habits.	**CLO1, CLO2**

Unit II **10Hrs**	**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse	**CLO2, CLO3**
Unit III **10Hrs**	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, Nationalprogramme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	**CLO3, CLO4**
Unit IV **08Hrs**	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.	**CLO4, CLO5**
Unit V **07Hrs**	**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.	**CLO5**

Recommended Books:

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications

2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications

3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications

4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications

5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.

6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers,Hyderabad

Recommended Journals:

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

PHARMAMARKETING MANAGEMENT (Theory)

COURSE CODE: BP803ET

Credits: 8

L-6	T-2	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand know how of marketing management and grooming the people for taking a challenging role in Sales and Product management.
CLO2	Apply new product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.
CLO3	Analyze distinguish the methods, determinants of promotional mix, promotional budget; Analyzing consumer buying behavior; industrial buying behavior.
CLO4	Evaluatation of the various policies for drug inventory management.
CLO5	Create retail and wholesale marketing.

Course Content:

UNITS/HOURS	CONTENTS	MAPPING
Unit I **10Hrs**	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behaviour. **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.	**CLO1, CLO3**
Unit II **10Hrs**	**Product decision:** Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging	**CLO2**

	and labeling decisions, Product management in pharmaceutical industry.	
Units III **10Hrs**	**IPR:** Introduction of IPR, Types of IPR, WIPO, and Procedure to protect IPR in India. **Promotion:** 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.	**CLO3**
Unit IV **10Hrs**	**Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **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.	**CLO4**
Unit V **10Hrs**	**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). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	**CLO5**

Recommended Books:

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi .15th edtion 2014

2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MCGrawHill, New Delhi. 3rd revised edition 1999

3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill .7th edtion 2021

4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India .3rd edtion 2016

5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition) .6th edtion 2016

6. Ramaswamy, U.S &Nanakamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi. 4th edition 2010

7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi . 2002

8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT– Excel series) Excel Publications. 2005

PHARMACEUTICAL REGULATORY SCIENCE (Theory)

COURSE CODE: BP804ET

Credits: 08

L-6	T-2	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand about the process of drug discovery and development.
CLO2	Apply clinical studies, Innovator and generics, Concept of generics, Generic drug Product development.
CLO3	Analyze about legal aspects and quality polices for drug manufacturing
CLO4	Evaluate the regulatory approval process and their registration in Indian and international markets.
CLO5	Identify the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

Course Content:

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	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.	**CLO1, CLO2**

Unit II **10Hrs**	**Regulatory Approval Process** Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA. **Regulatory authorities and agencies** Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	**CLO4**
Unit III **10Hrs**	**Registration of Indian drug product in overseas market** 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.	**CLO3, CLO4**
Unit IV **08Hrs**	**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	**CLO5**
Unit V **07Hrs**	**Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	**CLO5**

Recommended books:

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.4th edtion 2020

2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Health care Publishers. 2nd edition 2008

3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190. 5th edtion 2009

4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.1st edtion 2009

5. FDARegulatoryAffairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus. 3rd edtion 2008

6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143 1st edition 2004

7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance ByFayA. Rozovsky and RodneyK. Adams 1st edtion 2003

8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene .3rd edtion 2012

9. Drugs: From Discovery to Approval, Second Edition ByRick Ng 2nd edition 2009

PHARMACOVIGILANCE (Theory)

COURSE CODE: BP805T

Credits: 08

L-6	T-2	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand about national and international scenario of pharmacovigilance
CLO2	Apply the various methods that can be used to generate safety data and signal detection
CLO3	Develop the skills of classifying drugs, diseases and adverse drug reactions.
CLO4	Evaluate why drug safety monitoring is important.
CLO5	Create differences in Indian and global pharmacovigilance requirements.

Course Content:

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	**Introduction to Pharmacovigilance** •History and development of Pharmacovigilance •Importance of safety monitoring of Medicine •WHO international drug monitoring programme •Pharmacovigilance Program of India (PvPI). **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	**CLO1, CLO2**

	•Management of adverse drug reactions Basic terminologies used in pharmacovigilance •Terminologies of adverse medication related events •Regulatory terminologies.	
Unit II **10Hrs**	**Drug and disease classification** •Anatomical, therapeutic and chemical classification of drugs •International classification of diseases •Daily defined doses •International Non proprietary Names for drugs **Drug dictionaries and coding in pharmacovigilance** •WHO adverse reaction terminologies •MedDRA and Standardised MedDRA queries •WHO drug dictionary •Eudravigilance medicinal product dictionary. **Information resources in pharmacovigilance** •Basic drug information resources •Specialised resources for ADRs. **Establishing pharmacovigilance programme** •Establishing in a hospital •Establishment & operation of drug safety department in industry Contract Research Organisations (CROs) •Establishing a national programme.	**CLO3**

Unit III **10Hrs**	**Vaccine safety surveillance** •Vaccine Pharmacovigilance •Vaccination failure •Adverse events following immunization. **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. **Communication in pharmacovigilance** •Effective communication in Pharmacovigilance •Communication in Drug Safety Crisis management •Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	**CLO3**
Unit IV **08Hrs**	**Safety data generation** •Preclinical phase •Clinical phase •Post approval phase (PMS). **ICH Guidelines for Pharmacovigilance** •Organization and objectives of ICH •Expedited reporting •Individual case safety reports •Periodic safety update reports	**CLO4**

	•Post approval expedited reporting •Pharmacovigilance planning •Good clinical practice in pharmacovigilance studies.	
Unit V **07Hrs**	**Pharmacogenomics of adverse drug reactions** •Genetics related ADR with example focusing PK parameters. **Drug safety evaluation in special population** •Paediatrics •Pregnancy and lactation •Geriatrics **CIOMS** •CIOMS Working Groups •CIOMS Form **CDSCO (India) and Pharmacovigilance** •D&C Act and Schedule Y •Differences in Indian and global pharmacovigilance requirements	**CLO4, CLO5**

Recommended Books:

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers. 1st edition 2011

2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.1st edition 2008

3. Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers. 3rd edtiin 2014

4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, WileyPublishers. 5tth edition 2004

5. An Introduction to Pharmacovigilance: Patrick Waller,WileyPublishers. 2nd edition 2017

6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers. 3rd edition 2019

7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers. 3rd edition 2021

8. A Textbook of Clinical Pharmacy Practice-Essential Concepts and Skills:G. Parthasarathi, Karin NyfortHansen,Milap C. Nahata 2012

9. National Formulary of India

10. Text Book of Medicine by Yashpal Munjal 9th edition 2015

11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna 2nd edition 2020

QUALITY CONTROL AND STANDARDIZATION OF HERBALS

COURSE CODE: BP806ET

Credits: 08

L-6	T-2	P-0

Course Outcomes:
On the successful completion of this course, students will be able to:

CLO	Statement
CLO 1	Understand the regulatory approval process and registration of herbal drugs in Indian and International markets.
CLO 2	Apply WHO guidelines for quality control of herbal drugs.
CLO 3	Analyze EU and ICH guidelines for quality control of herbal drugs.
CLO 4	Evaluate quality assurance in herbal drug industry
CLO 5	Create preparation of documents for new drug application and export registration

Course Content:

UNITS/HOURS	CONTENTS	MAPPING
UNIT I **10Hrs**	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	**CLO1, CLO3**
UNIT II **10Hrs**	Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	**CLO2**
UNIT III **10Hrs**	EU and ICH guidelines for quality control of herbal drugs.	**CLO3**

	Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.	
UNIT IV **08Hrs**	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 GM Prequirements and Drugs & Cosmetics Act provisions.	**CLO4, CLO5**
UNIT V **07Hrs**	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	**CLO5**

Recommended Books:

1. Pharmacognosy by Trease and Evans .

2. Pharmacognosy by Kokate, Purohit and Gokhale .

3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.

4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.

5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products.

6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

7. 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.

8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. 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, 1998.

9. WHO. The International Pharmacopeia, Vol. 2: QualitySpecifications, 3rd edn. World Health Organization, Geneva, 1981.

10. WHO. QualityControl Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.

11. WHO. WHO Global Atlas of Traditional, Complementaryand Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.

12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

COMPUTER AIDED DRUG DESIGN (Theory)

COURSE CODE: BP807ET

Credits: 08

L-6	T-2	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand design and discovery of lead molecule .Stages of drug discovery and development
CLO2	Apply 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.
CLO3	Analyze the concept of QSAR and docking
CLO4	Evaluate about various strategies to design and develop new drug.
CLO5	Create design new drug molecules using molecular modeling software.

COURSE CONTENT

UNITS/HOURS	CONTENT	MAPPING
Unit I **10Hrs**	**Introduction to Drug Discovery and Development** Stages of drug discovery and development **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. **Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies.	**CLO1, CLO2**

Unit II **10Hrs**	**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, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.	**CLO3**
Unit III **10Hrs**	**Molecular Modeling and Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening, **Molecular docking:** Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.	**CLO4**
Unit IV **08Hrs**	**Informatics & Methods in drug design** Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	**CLO4**
Unit II **07Hrs**	**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.	**CLO4, CLO5**

Recommended Books

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore. 1977

2. Martin YC. "Quantitative Drug Design" Dekker, New York. 2nd edition 1978

3. Delgado JN, Remers WA eds "Wilson &Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.

4. Foye WO"Principles of Medicinal chemistry'Lea&Febiger.

5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.

6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley& Sons, New York.

7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.

8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.

9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

CELL AND MOLECULAR BIOLOGY (Elective subject)

COURSE CODE: BP808ET

Credits: 08

L-6	T-2	P-0

Course Outcomes:

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

CLO	Statement
CLO1	Understand the chemical foundation of cell biology know about the cellular Functioning and composition
CLO2	Apply the Flow of Molecular Information, DNA and RNA Functioning, Types of RNA
CLO3	Understand about various amino acids, proteins and pathways
CLO4	Evaluate and comprehend the genetics and genetic engineering
CLO5	Create and recognize about the history of cell and molecular biology

Course Content:

UNITS/HOURS	CONTENTS	MAPPING
Unit I **10Hrs**	a) Cell and Molecular Biology: Definitions theory and basics and Applications. b) Cell and Molecular Biology: History and Summation. c) Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations– an Introduction and Reactions (Types)	**CLO1**
Units II **10Hrs**	a) DNA and the Flow of Molecular Information b) DNA Functioning	**CLO2**

	c) DNA and RNA d) Types of RNA e) Transcription and Translation	
Unit III **10Hrs**	a) Proteins: Defined and Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	**CLO3**
Unit IV **08Hrs**	a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	**CLO4**
Unit V **07Hrs**	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	**CLO5**

Recommended Books:

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. 8th edition 2011

2. Prescott and Dunn., Industrial Microbiology, 4th edition 2004, CBS Publishers & Distributors, Delhi.

3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill 5th edn. 1986

4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.8th edition 1964

5. Rose: Industrial Microbiology.2019

6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed 1974. Japan .

7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution. 12th edition 2008

8. Peppler: Microbial Technology. 2nd edition1979

9. Edward: Fundamentals of Microbiology. 5th edition 1996

10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi .3rd edition 2019

11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company .2nd edition 2010

12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology:5th edition 2002 Principles and Applications of RecombinantDNA: ASM Press Washington D.C.

13. RA Goldshy et. al., : Kuby Immunology.8th edition 2022

COSMETIC SCIENCE

Course Code: BP809ET

Credits: 08

L -6	T-2	P-0

Course Learning Outcomes:
On successful completion of this course, the students will be able to

CLO	Statement
CLO1	Understand the basic science and physiology to develop cosmetics.
CLO2	Apply scientific knowledge to develop cosmetics and with desired safety, stability, and efficacy.
CLO3	Use key ingredients used in cosmetics and cosmeceuticals for various formulations
CLO4	Evaluate evolution of cosmeceuticals from cosmetics, cosmetics as quasiand OTC drugs
CLO5	Understand the cosmetics problem associated with skin, hair etc.

Course Contents:

Units/hours	Contents	Mapping
Unit 1 **10 hrs**	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 **Cosmetic excipients**: Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application **Skin**: Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums.	**CLO1**

Unit 2 **10 hrs**	**Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.Application of these products in formulation of cosmecuticals. **Antiperspants& deodorants-** Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products**: Conditioning shampoo, Hair conditioner,anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylenediamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.	**CLO2, CLO3**
Unit 3 **10 hrs**	Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove **Analytical cosmetics**: BIS specification and analytical methods for shampoo, skin- cream and toothpaste.	**CLO3**
Unit 4 **10 hrs**	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 benfits.	**CLO4**
Unit 5 **10 hrs**	Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. 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	**CLO5**

References

1) Harry's Cosmeticology, Wilkinson, Moore,7th Edition,1982 George Godwin.

2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4 th Edition,1998 Vandana Publications Pvt. Ltd., Delhi.

3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.2011

PHARMACOLOGICAL SCREENING METHODS
Course Code: BP010T

Credits: 08

L -6	T-2	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.
CLO2	Apply the application of various commonly used laboratory animals.
CLO3	Create the various screening methods used in preclinical research.
CLO4	Evaluation of biostatistics and research methodology, Appreciate the application of various commonly used laboratory animals.
CLO5	Analyze topic, review of literature, research hypothesis and study design Pre-clinical data analysis

Course Contents:

Units/ hours	Contents	Mapping
Unit 1 **10 hrs**	**Laboratory Animals:** Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications 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.	**CLO1**
Unit 2 **10 hrs**	**Preclinical screening models** a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control	**CLO2**

	groups. Rationale for selection of animal species and sex for the study. b. Study of screening animal models for Diuretics, nootropics, anti-Parkinson's,antiasthmatics, Preclinical screening models: for CNS activity-analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	
Unit 3 **10 hrs**	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	**CLO2, CLO3**
Unit 4 **10 hrs**	**Preclinical screening models**: for CVS activity-antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics. **Research methodology and Bio-statistics** 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	**CLO4, CLO5**

Recommended Books:

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh 6th edition 2008
2. Hand book of Experimental Pharmacology-S.K.Kulakarni 2014
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G. 3rd edition 2007
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta 3rd edition 2016
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard 5th edition 2012

ADVANCED INSTRUMENTATION TECHNIQUES
Course Code: BP811 ET

Credits: 08

L -6	T-2	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the advanced techniques and instruments used and their applications in drug analysis.
CLO2	Apply the chromatographic separation and analysis of drugs
CLO3	Analyze the subject that deals with the application of instrumental methods in qualitative and quantitative analysis of drugs
CLO4	Evaluation comprehend the calibration of various analytical instruments
CLO5	Create general principle and procedure involved in the solid phase extraction and liquid-liquid extraction

Course Contents:

Units/hours	Contents	Mapping
Unit I **10 hrs**	**Nuclear Magnetic Resonance spectroscopy** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications **Mass Spectrometry-** Principles, Fragmentation, Ionization techniques 21 Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	**CLO1**
Unit 2 **10 hrs**	**Thermal Methods of Analysis**: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) **X-Ray Diffraction Methods**: Origin of X-rays, basic aspects of crystals, X-ray Crystallography,	**CLO1, CLO2**

	rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications	
Unit 3 **10 hrs**	**Calibration and validation**-as per ICH and USFDA guidelines **Calibration of following Instruments** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, 179 Fluorimeter, Flame Photometer, HPLC and GC	**CLO3**
Unit 4 **10 hrs**	**Radio immune assay**: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay **Extraction techniques**: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	**CLO2, CLO3, CLO5**
Unit 5 **10 hrs**	**Hyphenated techniques-**LC-MS/MS, GC-MS/MS, HPTLC-MS	**CLO1, CLO4**

Recommended Books

1. Instrumental Methods of Chemical Analysis by B.K Sharma 1st edition 2011
2. Organic spectroscopy by Y.R Sharma 5th edition 2013
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors 3rd edition 2007
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel 6th edition 2009
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake 4th edition 2005
6. Organic Chemistry by I. L. Finar 5th edition 2005
7. Organic spectroscopy by William Kemp 2nd 2019
8. Quantitative Analysis of Drugs by D. C. Garrett 3rd edition 1976
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi 3rd edition 1976
10. Spectrophotometric identification of Organic Compounds by Silverstein 8th edition 2014

DIETARY SUPPLEMENTS AND NUTRACEUTICALS
Course Code: BP 812 ET

Credits: 08

L -6	T-2	P-0

Course Learning Outcomes:

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

CLO	Statement
CLO1	Understand the outcomes of deficiencies in dietary supplements.
CLO2	Apply public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.
CLO3	Evaluate the regulatory and commercial aspects of dietary supplements including health claims, Free radicals and their role in different diseases

Course Contents:

Units/hours	Contents	Mapping
Unit 1 **10 hrs**	a. **Definitions 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. b. **Public health nutrition**, maternal and child nutrition, nutrition and ageing, nutrition education in community. c. **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	**CLO1, CLO2**

Unit 2 **10 hrs**	**Phytochemicals as nutraceuticals**: Occurrence and characteristic features(chemical nature medicinal benefits) of following a)**Carotenoids**- α and β-Carotene, Lycopene, Xanthophylls, leutin b)**Sulfides:** Diallyl sulfides, Allyl trisulfide. c)**Polyphenolics**: Reservetrol d)**Flavonoids**- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones e)**Prebiotics/Probiotics**.:Fructo oligosaccharides, Lactobacillum f)**Phyto estrogens** : Isoflavones, daidzein, Geebustin, lignans g)**Tocopherols** h)**Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods**: oats, wheat bran, rice bran, sea foods, coffee, tea and the like	**CLO2, CLO3**
Unit 3 **10 hrs**	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.	**CLO3**
Unit 4 **10 hrs**	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 radicals theory of ageing. b) Antioxidants: Endogenous antioxidants–enzymatic and nonenzymatic antioxidant	**CLO3**

	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	
Unit 5 **10 hrs**	a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.	**CLO3**

References:

1. **Dietetics** by Sri Lakshmi 8th edition 2019

2. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988.

3. Advanced Nutritional Therapies by Cooper. K.A., (1996).

4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., 2011).

5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2 nd Edn., Avery Publishing Group, NY (1997).

6. G. Gibson and C.williams Editors 1st edition 2000 Functional foods Woodhead Publ.Co.London.

7. Goldberg, I. Functional Foods. 1st 1994. Chapman and Hall, New York.

8. Labuza, T.P. 2000 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. Aspen Press. 2000

9. Handbook of Nutraceuticals and Functional Foods,3rd Edition 2020(Modern Nutrition)

10. Shils, ME, Olson, JA, Shike, M. 1994 Modern Nutrition in Health and Disease 8th edition. Lea and Febiger

Elective course on Pharmaceutical Product Development

Credit: 4

L -3	T-1	P-0

CLO	Statement
CLO1	Understand the basic and advanced concepts of product developments, analyze the scope of regulatory guideline, quality certifications applicable to pharmaceutical products and industries
CLO2	Formulate advanced study of Pharmaceutical Excipients.
CLO3	Study the various optimization techniques for pharmaceutical product development
CLO4	Acquire a thorough understanding of important QC, QA

Course Content

Units/hours	Contents	Mapping
1 10 hrs	Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms	CLO1 21
2 10 hrs	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a	CLO2

	special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitols v. Suspending and emulsifying agents vi. Semi solid excipients	
3 10 hrs	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 aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with	CLO2 21

	specific industrial applications	
4 8hrs	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.	CLO3
5 7hrs	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations	CLO4

Recommended Books

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton,5th edition 2010
CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, ThirdEdition 2006 ,Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman and Leon Lachman; Marcel Dekker, Inc. 2nd edition 1990
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by RoopkKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and DistributorsPvt.Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition,2005 edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas andR. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2016.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr.,

Nicholas B.Popovich, Howard C. Ansel, 8th Ed.2008
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E.Aulton,3rd Ed.2007
9. Remington – The Science and Practice of Pharmacy, 23rd Ed 2021.
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman and Joseph B. Schwartz 2nd edition 1989
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman,
Martin, M.R and Gilbert S. Banker , 2nd edition 2020
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. AvisandH.A. Libermann. 2nd edition 1992
13. Advanced Review Articles related to the topics.Howard C. Ansel, 9th Ed. 2001
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed. 2007
9. Remington – The Science and Practice of Pharmacy, 23rd Ed. 2021
10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman and Joseph B. Schwartz 2nd edition 1989
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker. 2nd edition 1996
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis and H.A. Libermann. 2nd edition 1992