Pt. Ravishankar Shukla University,
Raipur (C.G.), India 492010

CURRICULUM & Syllabus
(Based on CBCS & LOCF)

B. Pharm.
(Semester System)

Semester: I-VIII

Session: 2025-2029

टीपः– सत्र. 2024.2025 के पाठ्यक्रम को सत्र 2025.2026.....के लिए यथावत प्रभावशील किया जाता है।

Approved by	:	
Board of Studies	:	Pharmacy
Dates	:	16-05-2025
Name of Chairman	:	Dr. S. J. Daharwal
Name of Member's	:	Dr. Preeti K. Suresh
		Dr. Manju Singh
		Dr. Amber Vyas
		Dr. Deependra Singh

B. Pharm

The Bachelor of Pharmacy (B. Pharm.) is a 4-year undergraduate degree program in the field of pharmaceutical sciences. It is designed for students interested in drug development, formulation, testing, and the safe and effective use of medications.

Program Outcomes (POs) of B. Pharm

PO-1: Knowledge

Apply knowledge of pharmacy fundamentals, including natural product chemistry, pharmacognosy, and traditional medicine systems to understand and contribute to health care practices and plant-based drug development.

PO-2: Critical Thinking and Reasoning

Identify, analyze, and critically evaluate scientific problems related to herbal drugs and natural products using phytochemical and pharmacognostic principles, ensuring evidence-based reasoning.

PO-3: Problem Solving

Develop and apply effective planning, resource management, and methodological strategies to solve problems in herbal drug research, authentication, and formulation.

PO-4: Advanced Analytical and Computational Skills

Use advanced chromatographic, spectroscopic, and computational tools (e.g., TLC, HPTLC, HPLC, FTIR, UV-Vis, chemometrics) in standardization, quality control, and phytochemical research.

PO-5: Effective Communication

Communicate effectively with scientific, regulatory, and community stakeholders to share findings related to herbal drugs and traditional medicine in oral and written formats.

PO-6: Social/Interdisciplinary Interaction

Engage with communities, traditional healers, and interdisciplinary experts (botany, chemistry, medicine) to promote culturally sensitive and socially responsible herbal medicine practices.

PO-7: Self-directed and Life-long Learning

Demonstrate a commitment to continuous learning in the evolving fields of natural product research, regulatory sciences, and global traditional medicinal systems.

PO-8: Effective Citizenship: Leadership and Innovation

Exhibit leadership in initiating sustainable medicinal plant cultivation, developing novel herbal formulations, and leading teams in herbal industry and research sectors.

PO-9: Ethics

Apply ethical principles in research and practice involving traditional knowledge, plant resources, and benefit-sharing in compliance with laws such as the Biodiversity Act and Nagoya Protocol.

PO-10: Further Education or Employment

Build a strong professional identity for career advancement in herbal industries, research organizations, regulatory bodies, and academia through ethical and skill-based competence.

PO-11: Global Perspective

Understand and contribute to the global relevance of pharmacognosy, ensuring sustainable use of medicinal plants and promoting herbal medicine integration in global healthcare systems.

Program Specific Outcomes (PSO)

•PSO 1 – Drug Development and Formulation
Apply knowledge of pharmaceutics to design, formulate, and evaluate safe and effective pharmaceutical dosage forms.

- **PSO 2 – Pharmacological Expertise**

Understand drug mechanisms, therapeutic uses, and adverse effects to ensure rational and evidence-based medication use.

- **PSO 3 – Analytical and Quality Control Skills**

Use modern analytical techniques to ensure the identity, strength, quality, and purity of pharmaceutical substances.

- **PSO 4 – Industrial and Regulatory Knowledge**

Demonstrate proficiency in pharmaceutical manufacturing processes and knowledge of regulatory guidelines and Good Manufacturing Practices (GMP).

- **PSO 5 – Clinical and Community Pharmacy Practice**

Provide patient-centric services including drug information, counseling, and public health promotion in clinical and community settings.

Semester-I

Program	Subject	Year	Semester
B. Pharm.	Human Anatomy and Physiology I	I	I

Course Code	Course Title	Course Type
BP101T	Human Anatomy and Physiology I	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Describe the structure and function of various organ systems in the human body including circulatory, respiratory, nervous, and digestive systems.	Ap
2	Explain the physiological processes and mechanisms involved in maintaining homeostasis.	Ap
3	Correlate anatomical structures with their physiological roles and apply this knowledge in understanding disease conditions.	U
4	Demonstrate basic laboratory skills related to anatomy and physiology, such as identification of tissues and measurement of vital signs.	An
5	Apply concepts of human anatomy and physiology in pharmacy practice, including drug action, administration routes, and patient counseling.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	10	1
II	**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	10	2
III	**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	10	3
IV	**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.	8	4
V	**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.	7	5

Semester-I

Program	Subject	Year	Semester
B. Pharm.	Human Anatomy and Physiology I Practical	I	I
Course Code	Course Title		Course Type
BP107P	Human Anatomy and Physiology I Practical		Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
02	-	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	**CO1:** Understand the structure and functions of human cell, tissues, and basic physiological processes.	Ap
2	**CO2:** Explain the anatomy and physiology of the integumentary, skeletal, muscular, and nervous systems.	Ap
3	**CO3:** Describe the functions of blood, lymph, and components of the cardiovascular system.	U
4	**CO4:** Interpret homeostatic mechanisms and their role in maintaining normal body functions.	An
5	**CO5:** Apply knowledge of human physiology to understand the basis of health, disease, and pharmacological interventions.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

LIST OF PRACTICALS
Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject. 1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) count 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of hemoglobin content 12. Determination of blood group. 13. Determination of erythrocyte sedimentation rate (ESR). 14. Determination of heart rate and pulse rate. 15. Recording of blood pressure.

Books Recommended:

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

Semester-I

Program	Subject	Year	Semester
B. Pharm.	Pharmaceutical Analysis-I	I	I

Course Code	Course Title	Course Type
BP102T	Pharmaceutical Analysis-I	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the principles and applications of various analytical techniques including acid-base, redox, complexometric, and non-aqueous titrations.	Ap
2	Explain the importance of analytical chemistry in quality control and assurance of pharmaceuticals.	Ap
3	Perform volumetric and gravimetric analysis with accuracy and interpret the results for pharmaceutical substances.	U
4	Demonstrate proficiency in handling laboratory instruments such as pH meters, conductivity meters, and potentiometers.	An
5	Apply analytical methods to identify, estimate, and validate pharmaceutical compounds in compliance with pharmacopeial standards.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	(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 (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.	10	1
II	**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	10	2
III	**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.	8	3
IV	**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	8	4
V	**Electrochemical methods of analysis** **Conductometry-** Introduction, Conductivity cell, Conductometric titrations, applications. **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	7	5

Semester -I

Program	Subject	Year	Semester
B. Pharm.	Pharmaceutical Analysis - I Practical	I	I

Course Code	Course Title	Course Type
BP108P	Pharmaceutical Analysis -I Practical	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	04

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the principles and applications of various analytical techniques including acid-base, redox, complexometric, and non-aqueous titrations.	Ap
2	Explain the importance of analytical chemistry in quality control and assurance of pharmaceuticals.	Ap
3	Perform volumetric and gravimetric analysis with accuracy and interpret the results for pharmaceutical substances.	U
4	Demonstrate proficiency in handling laboratory instruments such as pH meters, conductivity meters, and potentiometers.	An
5	Apply analytical methods to identify, estimate, and validate pharmaceutical compounds in compliance with pharmacopeial standards.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).CO-

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

LIST OF PRACTICALS
I-Limit Test of the following (1) Chloride (2) Sulphate (3) Iron (4) Arsenic **II -Preparation and standardization of** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate **III 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 non-aqueous titration (7) Sodium Chloride by precipitation titration **IV 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

Books Recommended:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone
2. Press of University of London
3. A.I. Vogel, Text Book of Quantitative Inorganic analysis
4. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. John H. Kennedy, Analytical chemistry principles
7. Indian Pharmacopoeia.

Semester -I

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICS- I	I	I
Course Code	Course Title		Course Type
BP103T	PHARMACEUTICS- I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the fundamental principles of pharmacy, including the history, scope, and different dosage forms.	Ap
2	Explain the formulation, preparation, and evaluation of basic pharmaceutical dosage forms such as solutions, suspensions, emulsions, and powders.	Ap
3	Describe the role and functions of pharmaceutical additives (excipients) and vehicles used in formulations.	U
4	Demonstrate practical skills in compounding and dispensing of various dosage forms following standard procedures.	An
5	Apply pharmaceutics knowledge to ensure the stability, effectiveness, and patient acceptability of pharmaceutical products.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	10	1
II	**Pharmaceutical calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Powders:** Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques	10	2
III	**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 ofEmulsion, Methods of preparation & stability problems and methods to overcome.	8	3
IV	**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.	8	4
V	**Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	7	5

Semester -I

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICS PRACTICAL	I	I

Course Code	Course Title	Course Type
BP109P	PHARMACEUTICS PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the fundamental principles of pharmacy, including the history, scope, and different dosage forms.	Ap
2	Explain the formulation, preparation, and evaluation of basic pharmaceutical dosage forms such as solutions, suspensions, emulsions, and powders.	Ap
3	Describe the role and functions of pharmaceutical additives (excipients) and vehicles used in formulations.	U
4	Demonstrate practical skills in compounding and dispensing of various dosage forms following standard procedures.	An
5	Apply pharmaceutics knowledge to ensure the stability, effectiveness, and patient acceptability of pharmaceutical products.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).CO-

PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation pply; **An**-Analyze; **E**-Evaluate; **C**-Create).

Detailed Syllabus:

LIST OF PRACTICALS
1 . Syrups a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 **2. Elixirs** a) Piperazine citrate elixir b) Paracetamol pediatric elixir **3.Linctus** a) Terpin Hydrate Linctus IP'66 b) Iodine Throat Paint (Mandles Paint) **4. Solutions** a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution **5. Suspensions** a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminimum Hydroxide gel **6. Emulsions** a) Turpentine Liniment b) Liquid paraffin emulsion **7. Powders and Granules** a) ORS powder (WHO) b) Effervescent granules c)Dusting powder d)Divded powders **8. Suppositories** a) Glycero gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository **8. Semisolids** a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel **9. Gargles and Mouthwashes** a) Iodine gargle b) Chlorhexidine mouthwash

Books Recommended:

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.
4. Indian Pharmacopoeia.
5. British Pharmacopoeia.
6. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan.
7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.
12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

Semester -I

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL INORGANIC CHEMISTRY	I	I
Course Code	Course Title		Course Type
BP104T	PHARMACEUTICAL INORGANIC CHEMISTRY		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the fundamental concepts, sources, and pharmaceutical applications of inorganic compounds used in medicine.	Ap
2	Classify and describe the roles of essential and trace elements in biological systems and their pharmaceutical importance.	Ap
3	Explain the methods of preparation, properties, uses, and storage conditions of official inorganic pharmaceutical compounds.	U
4	Perform qualitative and quantitative analysis of inorganic pharmaceutical substances using standard analytical techniques.	An
5	Apply knowledge of pharmaceutical inorganic chemistry in the evaluation of purity, safety, and efficacy of inorganic medicinal agents as per pharmacopeial standards.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
General methods of preparation, assay for the compounds superscripted with asterisk (*), properties and medicinal uses of inorganic compounds belonging to the following classes			
II	**Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of 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.	10	2
III	**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	10	3
IV	**Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite **Astringents:** Zinc Sulphate, Potash Alum	8	4
V	**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.	7	5

Semester -I

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL INORGANIC CHEMISTRY PRACTICAL	I	I

Course Code	Course Title	Course Type
BP110T	PHARMACEUTICAL INORGANIC CHEMISTRY PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	04

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the sources, properties, and pharmaceutical applications of inorganic compounds used in medicine.	Ap
2	Classify and describe various pharmaceutical aids and excipients of inorganic origin.	Ap
3	Explain the concepts of acidity, basicity, buffers, isotonicity, and their relevance in pharmaceutical formulations.	U
4	Perform qualitative and limit tests for identification and purity testing of inorganic substances as per pharmacopeial standards.	An
5	Apply knowledge of inorganic chemistry in assessing the safety, compatibility, and stability of pharmaceutical substances.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Practical List:

LIST OF PRACTICALS
I-Limit tests for following ions Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic **II Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate **III Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide **IV Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate

Books Recommended:

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

Semester -I

Program	Subject	Year	Semester
B. Pharm.	COMMUNICATION SKILLS	I	I

Course Code	Course Title	Course Type
BP105T	COMMUNICATION SKILLS	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	--	--

Maximum Marks	CIA	ESE
50	15	35

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the principles and types of communication, including verbal, non-verbal, written, and interpersonal communication.	Ap
2	Develop effective oral communication skills for academic, professional, and healthcare settings, including presentations and patient counseling.	Ap
3	Demonstrate proficiency in written communication, including report writing, official correspondence, and documentation relevant to pharmacy practice.	U
4	Apply listening and comprehension skills to engage effectively in professional discussions, interviews, and teamwork.	An
5	Use modern communication tools and technology (e.g., email, video conferencing, digital media) to enhance professional communication in pharmacy and healthcare contexts.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).CO-

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	7	1
II	**Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (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	7	2
III	**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	7	3
IV	**Interview Skills:** Purpose of an interview, Do's and Dont's of an interview **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	5	4
V	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion	4	5

Semester -I

Program	Subject	Year	Semester
B. Pharm.	COMMUNICATION SKILLS PRACTICAL	I	I

Course Code	Course Title	Course Type
BP105T	COMMUNICATION SKILLS PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
1	2	--	2

Maximum Marks	CIA	ESE
25	10	15

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the principles and types of communication, including verbal, non-verbal, written, and interpersonal communication.	Ap
2	Develop effective oral communication skills for academic, professional, and healthcare settings, including presentations and patient counseling.	Ap
3	Demonstrate proficiency in written communication, including report writing, official correspondence, and documentation relevant to pharmacy practice.	U
4	Apply listening and comprehension skills to engage effectively in professional discussions, interviews, and teamwork.	An
5	Use modern communication tools and technology (e.g., email, video conferencing, digital media) to enhance professional communication in pharmacy and healthcare contexts.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).CO-

PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Practical List:

LIST OF PRACTICALS
Thefollowing learning modules are to be conducted using wordsworth® English language lab software **Basic communication covering the following topics** Meeting People Asking Questions Making Friends What did you do? Do's and Dont's **Pronunciations covering the following topics** Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds) **Advanced Learning** Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills

Books Recommended:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1st Edition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1st Edition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5th Edition, 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, 2nd Edition, New arrivals – PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1st Edition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India Pvt.Ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1st Edition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4th Edition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 199

Semester -I

Program	Subject	Year	Semester
B. Pharm.	REMEDIAL BIOLOGY	I	I
Course Code	**Course Title**		**Course Type**
BP106RBT	REMEDIAL BIOLOGY		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	2	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic structure and functions of plant and animal cells, tissues, and organ systems.	Ap
2	Describe the anatomy and physiology of major human systems including circulatory, digestive, respiratory, and nervous systems.	Ap
3	Explain fundamental concepts of genetics, reproduction, and biological classification relevant to pharmaceutical sciences.	U
4	Identify the morphology and functions of different plant parts with pharmaceutical relevance.	An
5	Apply basic biological concepts to understand human health, diseases, and the biological basis of drug action.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	7	1
II	**Body fluids and circulation** Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels 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	7	2
III	**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 **Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands	7	3

	Human reproduction Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle		
IV	**Plants and mineral nutrition:** Essential mineral, macro and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	5	4
V	**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.	4	5

Books Recommended:

Text Books

a. Text book of Biology by S. B. Gokhale

b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

a. A Text book of Biology by B.V. Sreenivasa Naidu

b. A Text book of Biology by Naidu and Murthy

c. Botany for Degree students By A.C.Dutta.

d.Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.

e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

Semester -I

Program	Subject	Year	Semester
B. Pharm.	REMEDIAL BIOLOGY PRACTICAL	I	I

Course Code	Course Title	Course Type
BP106RBT	REMEDIAL BIOLOGY PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify and describe the structure and function of various plant parts with pharmaceutical relevance through practical observation.	Ap
2	Demonstrate the ability to prepare and observe animal and plant cells/tissues under a microscope.	Ap
3	Dissect and explain the anatomical features of selected specimens to understand basic organ systems.	U
4	Illustrate and label biological diagrams of human systems and plant anatomy.	An
5	Apply biological practical knowledge in understanding the fundamentals of human and plant biology relevant to pharmaceutical sciences.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Practical List:

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

Reference Books

1. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.
2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.
3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof M.J.H.Shafi

Semester -I

Program	Subject	Year	Semester
B. Pharm.	REMEDIAL MATHEMATICS	I	I

Course Code	Course Title	Course Type
BP106RMT	REMEDIAL MATHEMATICS	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic structure and functions of plant and animal cells, tissues, and organ systems.	Ap
2	Describe the anatomy and physiology of major human systems including circulatory, digestive, respiratory, and nervous systems.	Ap
3	Explain fundamental concepts of genetics, reproduction, and biological classification relevant to pharmaceutical sciences.	U
4	Identify the morphology and functions of different plant parts with pharmaceutical relevance.	An
5	Apply basic biological concepts to understand human health, diseases, and the biological basis of drug action.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function**: Real Valued function, Classification of real valued functions, **Limits and continuity** : Introduction , Limit of a function, Definition of limit of a function (ϵ - δ definition) , $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$, $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1$,	6	1
II	**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,Applicationof Matrices in solving Pharmacokinetic equations	6	2
III	**Calculus** **Differentiation** : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n *w.r.t*x,where *n* is any rational number, Derivative of e^x,, Derivative of $\log_e x$, Derivative of a^x,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application	6	3
IV	**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 Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application	6	4

V	**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**	6	5

Books Recommended:

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

Semester-II

Program	Subject	Year	Semester
B. Pharm.	Human Anatomy and Physiology II	I	II

Course Code	Course Title	Course Type
BP201T	Human Anatomy and Physiology II	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Describe the structure and function of various organ systems in the human body including circulatory, respiratory, nervous, and digestive systems.	Ap
2	Explain the physiological processes and mechanisms involved in maintaining homeostasis.	Ap
3	Correlate anatomical structures with their physiological roles and apply this knowledge in understanding disease conditions.	U
4	Demonstrate basic laboratory skills related to anatomy and physiology, such as identification of tissues and measurement of vital signs.	An
5	Apply concepts of human anatomy and physiology in pharmacy practice, including drug action, administration routes, and patient counseling.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, 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)	10	1
II	**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.	6	2
III	**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.	10	3
IV	**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.	10	4
V	**Reproductive system** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	9	5

Semester-II

Program	Subject	Year	Semester
B. Pharm.	Human Anatomy and Physiology II Practical	I	II
Course Code	Course Title		Course Type
BP207P	Human Anatomy and Physiology II Practical		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
02	-	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the structure and functions of human cell, tissues, and basic physiological processes.	Ap
2	Explain the anatomy and physiology of the integumentary, skeletal, muscular, and nervous systems.	Ap
3	Describe the functions of blood, lymph, and components of the cardiovascular system.	U
4	Interpret homeostatic mechanisms and their role in maintaining normal body functions.	An
5	Apply knowledge of human physiology to understand the basis of health, disease, and pharmacological interventions.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Practical List:

LIST OF PRACTICALS
1. To study the integumentary and special senses using specimen, models, etc., 2. To study the nervous system using specimen, models, etc., 3. To study the endocrine system using specimen, models, etc 4. To demonstrate the general neurological examination 5. To demonstrate the function of olfactory nerve 6. To examine the different types of taste. 7. To demonstrate the visual acuity 8. To demonstrate the reflex activity 9. Recording of body temperature 10. To demonstrate positive and negative feedback mechanism. 11. Determination of tidal volume and vital capacity. 12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 13. Recording of basal mass index 14. Study of family planning devices and pregnancy diagnosis test. 15. Demonstration of total blood count by cell analyser 16. Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

Semester-II

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ORGANIC CHEMISTRY –I	I	II
Course Code	Course Title		Course Type
BP202T	PHARMACEUTICAL ORGANIC CHEMISTRY – I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the structure, nomenclature, and stereochemistry of organic compounds relevant to pharmacy.	Ap
2	Explain reaction mechanisms and chemical behavior of functional groups in drug molecules.	Ap
3	Identify and synthesize pharmaceutical organic compounds using standard laboratory techniques.	U
4	Analyze the structure-activity relationship (SAR) to predict drug action and metabolism.	An
5	Apply organic chemistry principles to interpret drug interactions and stability.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences			
I	**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 isomerisms in organic compounds	7	1
II	**Alkanes*, Alkenes* and Conjugated dienes*** SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP^2 hybridization in alkenes E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement	10	2
III	**Alkyl halides*** SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 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	8	3
IV	**Carbonyl compounds* (Aldehydes and ketones)** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.	8	4

V	**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	8	5

Semester-II

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ORGANIC CHEMISTRY – I PRACTICAL	I	II

Course Code	Course Title	Course Type
BP208T	PHARMACEUTICAL ORGANIC CHEMISTRY –I PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the structure, nomenclature, and stereochemistry of organic compounds relevant to pharmacy.	Ap
2	Explain reaction mechanisms and chemical behavior of functional groups in drug molecules.	Ap
3	Identify and synthesize pharmaceutical organic compounds using standard laboratory techniques.	U
4	Analyze the structure-activity relationship (SAR) to predict drug action and metabolism.	An
5	Apply organic chemistry principles to interpret drug interactions and stability.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS
A. 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 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. B. Preparation of suitable solid derivatives from organic compounds C. Construction of molecular models

Recommended Books (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

Semester-II

Program	Subject	Year	Semester
B. Pharm.	BIOCHEMISTRY	I	II
Course Code	Course Title		Course Type
BP203T	BIOCHEMISTRY		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Describe the structure and function of biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.	Ap
2	Explain metabolic pathways and their regulation in normal and diseased states.	Ap
3	Understand enzyme kinetics and their role in drug action and metabolism.	U
4	Correlate biochemical changes with pathological conditions relevant to pharmacy practice.	An
5	Apply biochemical principles in clinical diagnostics and therapeutic monitoring.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP	8	1
II	**Carbohydrate metabolism** Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance Hormonal regulation of blood glucose level and Diabetes mellitus **Biological oxidation** Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers	10	2
III	**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 Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia)	10	3

	Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice		
IV	**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	10	4
V	**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	7	5

Semester-II

Program	Subject	Year	Semester
B. Pharm.	BIOCHEMISTRY PRACTICAL	I	II
Course Code	Course Title		Course Type
BP209T	BIOCHEMISTRY PRACTICAL		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the structure, nomenclature, and stereochemistry of organic compounds relevant to pharmacy.	Ap
2	Explain reaction mechanisms and chemical behavior of functional groups in drug molecules.	Ap
3	Identify and synthesize pharmaceutical organic compounds using standard laboratory techniques.	U
4	Analyze the structure-activity relationship (SAR) to predict drug action and metabolism.	An
5	Apply organic chemistry principles to interpret drug interactions and stability.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

Semester-II

Program	Subject	Year	Semester
B. Pharm.	PATHOPHYSIOLOGY	I	II
Course Code	Course Title		Course Type
BP204T	PATHOPHYSIOLOGY		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes.This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Explain the mechanisms and causes of common diseases affecting various organ systems.	Ap
2	Correlate clinical signs and symptoms with underlying pathophysiological changes.	Ap
3	Understand the progression and complications of diseases relevant to pharmacy practice.	U
4	Interpret laboratory and diagnostic data for disease identification and management.	An
5	Apply knowledge of pathophysiology in the rational use of drugs and patient counseling.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
	Basic mechanism involved in the process of inflammation and repair: Introduction, Clinical signs of inflammation, Different types of Inflammation,Mechanism of Inflammation - Alteration in vascular permeability and blood flow, migration of WBC's,Mediators of inflammation,Basic principles of wound healing in the skin,Pathophysiology of Atherosclerosis Basic mechanism involved in the process of inflammation and repair: Introduction, Clinical signs of inflammation, Different types of Inflammation,Mechanism of Inflammation - Alteration in vascular permeability and blood flow, migration of WBC's,Mediators of inflammation,Basic principles of wound healing in the skin,Pathophysiology of Atherosclerosis		
II	**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	10	2
III	**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	10	3
IV	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 **Diseases of bones and joints:**Rheumatoid Arthritis, Osteoporosis,Gout **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer	8	4
V	Infectious diseases:Meningitis,Typhoid, Leprosy, Tuberculosis Urinary tract infections Sexually transmitted diseases:AIDS, Syphilis, Gonorrhea	7	5

Recommended Books (Latest Editions)

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; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th 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; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd 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.

Semester-II

Program	Subject	Year	Semester
B. Pharm.	COMPUTER APPLICATIONS IN PHARMACY	I	II
Course Code	Course Title		Course Type
BP205T	COMPUTER APPLICATIONS IN PHARMACY		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
3	3	--	--

Maximum Marks	CIA	ESE
75	25	50

Learning Objective (LO):
This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand basic computer hardware, software, and operating systems relevant to pharmacy.	Ap
2	Use common software tools like word processors, spreadsheets, and presentation software effectively.	Ap
3	Apply data management and database systems for handling pharmaceutical information.	U
4	Utilize computer applications in research, drug design, and pharmacy practice.	An
5	Demonstrate awareness of cyber security, data privacy, and ethical use of information technology.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Number system**: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software : I**nformation gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project	6	1
II	**Web technologies**:Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database.	6	2
III	**Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System	6	3
IV	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	6	4
V	**Computers as data analysis in Preclinical development**: Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)	6	5

Semester-II

Program	Subject	Year	Semester
B. Pharm.	COMPUTER APPLICATIONS IN PHARMACY PRACTICAL	I	II

Course Code	Course Title	Course Type
BP210P	COMPUTER APPLICATIONS IN PHARMACY PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
1	--	--	2

Maximum Marks	CIA	ESE
25	10	15

Learning Objective (LO):

Understand the Etiology and Mechanisms of Diseases

Learners will identify and explain the causes, development, and progression of common diseases affecting different organ systems.

Correlate Clinical Manifestations with Pathological Changes

Learners will analyze how clinical signs and symptoms arise from underlying biochemical and physiological disruptions in the body.

Apply Pathophysiological Knowledge in Pharmacy Practice

Learners will use their understanding of disease processes to support rational drug therapy, patient counseling, and interpretation of diagnostic tests.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand basic computer hardware, software, and operating systems relevant to pharmacy.	Ap
2	Use common software tools like word processors, spreadsheets, and presentation software effectively.	Ap
3	Apply data management and database systems for handling pharmaceutical information.	U
4	Utilize computer applications in research, drug design, and pharmacy practice.	An
5	Demonstrate awareness of cyber security, data privacy, and ethical use of information technology.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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

Recommended books (Latest edition):

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

Semester-II

Program	Subject	Year	Semester
B. Pharm.	ENVIRONMENTAL SCIENCES	I	II

Course Code	Course Title	Course Type
BP206T	ENVIRONMENTAL SCIENCES	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
3	3	--	--

Maximum Marks	CIA	ESE
75	25	50

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the multidisciplinary nature of environmental studies and the importance of natural resources.	Ap
2	Explain the structure and function of various ecosystems.	Ap
3	Analyze different types of environmental pollution.	U
4	Demonstrate awareness of environmental conservation practices.	An
5	Apply ecosystem knowledge to real-world environmental problems.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.	10	1
II	Ecosystems ▪ Concept of an ecosystem. ▪ Structure and function of an ecosystem. ▪ Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	10	2
III	Environmental Pollution: Air pollution; Water pollution; Soil pollution	10	3

Recommended Books (Latest edition):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad - 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., 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., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ORGANIC CHEMISTRY –II	II	III

Course Code	Course Title	Course Type
BP301T	PHARMACEUTICAL ORGANIC CHEMISTRY – II	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	CO1: Describe the mechanisms and orientation of electrophilic and nucleophilic substitution reactions in aromatic compounds. (Knowledge & Understanding)	Ap
2	CO2: Predict the reactivity and orientation of substituted aromatic compounds in various organic reactions. (Application & Analysis)	Ap
3	CO3: Classify and explain the chemistry, synthesis, and reactions of heterocyclic compounds of pharmaceutical importance. (Understanding & Evaluation)	U
4	CO4: Apply concepts of organic reaction mechanisms in the synthesis of medicinally important organic compounds. (Application)	U
5	CO5: Analyze the relationship between chemical structure and reactivity to solve synthetic and mechanistic problems. (Analysis & Synthesis)	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences			
I	**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, halogenation-reactivity, 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	10	1
II	**Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, 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.	10	2
III	**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.	10	3
IV	**Polynuclear hydrocarbons:** a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	8	4
V	**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	7	5

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ORGANIC CHEMISTRY –II PRACTICAL	II	III

Course Code	Course Title	Course Type
BP305T	PHARMACEUTICAL ORGANIC CHEMISTRY – II PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Perform purification and identification techniques such as crystallization, distillation, and chromatography.	Ap
2	Synthesize and characterize simple organic compounds through selected reactions (e.g., nitration, sulfonation, halogenation).	Ap
3	Demonstrate proper use of laboratory apparatus and safety protocols in handling chemicals and conducting organic reactions.	U
4	Analyze experimental data to interpret reaction mechanisms and yield.	An
5	Document and present experimental findings effectively with clarity and precision.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS

I **Experiments involving laboratory techniques**

- Recrystallization
- Steam distillation

II **Determination of following oil values (including standardization of reagents)**

- Acid value
- Saponification value
- Iodine value

III **Preparation of compounds**

- Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.
- 2,4,6-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.
- 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 (Latest Editions)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHYSICAL PHARMACEUTICS-I	II	III
Course Code	Course Title		Course Type
BP302T	PHYSICAL PHARMACEUTICS-I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand physical principles governing drug dosage form design.	Ap
2	Analyze solubility, dissolution, and stability of pharmaceutical systems.	Ap
3	Apply rheological and particle size concepts in formulation.	U
4	Evaluate physicochemical properties affecting drug delivery.	U
5	Perform calculations related to physical pharmacy processes.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 applications. Distribution law, its limitations and applications	10	1
II	**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	10	2
III	**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.	8	3
IV	**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.	8	4
V	**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.	7	5

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHYSICAL PHARMACEUTICS-I PRACTICAL	II	III
Course Code	Course Title		Course Type
BP306P	PHYSICAL PHARMACEUTICS-I PRACTICAL		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Determine and interpret solubility, pKa, and partition coefficient of drugs using experimental methods.	Ap
2	Measure and evaluate dissolution rate and diffusion behavior of pharmaceutical substances.	Ap
3	Apply and analyze rheological and surface tension measurements in formulation studies.	U
4	Perform and interpret particle size distribution and flow property assessments.	An
5	Record, calculate, and report experimental data accurately with appropriate scientific reasoning and communication skills.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS
1. Determination the solubility of drug at room temperature 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation. 3. Determination of Partition co- efficient of benzoic acid in benzene and water 4. Determination of Partition co- efficient of Iodine in CCl_4 and water 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method 6. Determination of surface tension of given liquids by drop count and drop weight method 7. Determination of HLB number of a surfactant by saponification method 8. Determination of Freundlich and Langmuir constants using activated char coal 9. Determination of critical micellar concentration of surfactants 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
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.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL MICROBIOLOGY	II	III

Course Code	Course Title	Course Type
BP303T	PHARMACEUTICAL MICROBIOLOGY	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
Study of all categories of microorganisims especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc..

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand microbial taxonomy and growth characteristics.	Ap
2	Apply aseptic techniques and sterilization methods.	Ap
3	Identify pathogens and assess antimicrobial susceptibility.	U
4	Interpret microbiological quality control of pharmaceuticals.	U
5	Demonstrate knowledge of vaccines and microbial biotechnology.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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 phase constrast microscopy, dark field microscopy and electron microscopy.	10	1
II	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 gaseous,radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators.	10	2
III	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.	10	3
IV	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.	8	4
V	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.	7	5

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL MICROBIOLOGY PRACTICAL	II	III

Course Code	Course Title	Course Type
BP307T	PHARMACEUTICAL MICROBIOLOGY PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
Study of all categories of microorganisims especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc..

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Determine solubility, pKa, and partition coefficient of pharmaceutical substances experimentally.	Ap
2	Measure dissolution rate and study diffusion behavior of drugs.	Ap
3	Analyze surface tension, viscosity, and rheological behavior of formulations.	U
4	Evaluate particle size distribution and flow properties of powders.	An
5	Interpret experimental data and present observations in a scientifically sound format.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS
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. 2. Sterilization of glassware, preparation and sterilization of media. 3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical). 5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques. 6. Microbiological assay of antibiotics by cup plate method and other methods 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals. 9. Bacteriological analysis of water 10. Biochemical test.

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ENGINEERING	II	III
Course Code	Course Title		Course Type
BP304T	PHARMACEUTICAL ENGINEERING		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand principles of pharmaceutical manufacturing processes.	Ap
2	Apply heat transfer, fluid flow, and material handling in industry.	Ap
3	Design and optimize unit operations in drug production.	U
4	Analyze equipment used in pharmaceutical processing.	U
5	Implement quality and safety standards in engineering operations.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	10	1
II	**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	10	2
III	**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, Propellers, Turbines, Paddles & Silverson Emulsifier,	8	3
IV	**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.	8	4

V	**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.	7	5

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Semester-III

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ENGINEERING PRACTICAL	II	III

Course Code	Course Title	Course Type
BP306P	PHARMACEUTICAL ENGINEERING PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Demonstrate the operation of basic pharmaceutical engineering equipment such as ball mill, fluidized bed dryer, and sieve shaker.	Ap
2	Determine particle size, size distribution, and surface area using various experimental techniques.	Ap
3	Evaluate flow properties and mixing efficiency of pharmaceutical powders.	U
4	Analyze heat transfer and drying kinetics in pharmaceutical unit operations.	An
5	Apply safety, quality, and GMP considerations in pharmaceutical engineering experiments.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL ORGANIC CHEMISTRY – III	II	IV
Course Code	Course Title		Course Type
BP401T	PHARMACEUTICAL ORGANIC CHEMISTRY – III		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the chemistry and reactivity of heterocyclic compounds relevant to pharmaceutical agents.	Ap
2	Classify and analyze medicinally important heterocycles and their synthesis pathways.	Ap
3	Explain the structure-activity relationship (SAR) of key heterocyclic drugs.	U
4	Apply organic reactions and synthetic methods in the development of drug molecules.	U
5	Interpret reaction mechanisms and predict the behavior of organic compounds in pharmaceutical synthesis.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS

I. Determination of radiation constant of brass, iron, unpainted and painted glass.
II. Steam distillation – To calculate the efficiency of steam distillation.
III. To determine the overall heat transfer coefficient by heat exchanger.
IV. IConstruction of drying curves (for calcium carbonate and starch).
V. Determination of moisture content and loss on drying.
VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.
VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic andlogarithmic probability plots.
IX. 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.
X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment.

XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
XII. To study the effect of time on the Rate of Crystallization.

XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	MEDICINAL CHEMISTRY –I	II	IV
Course Code	Course Title		Course Type
BP402T	MEDICINAL CHEMISTRY –I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand chemical basis of drug action.	Ap
2	Analyze structure-activity relationships of drugs.	Ap
3	Explain synthesis and metabolism of drug molecules.	U
4	Design novel drug candidates using medicinal chemistry principles.	U
5	Apply chemical knowledge in rational drug development.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
To emphasize on definition, types, mechanisms, examples, uses/applications			
I	**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, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute	10	1
II	**Geometrical isomerism** 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	10	2
III	**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	10	3
IV	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	8	4
V	**Reactions of synthetic importance** Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	7	5

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

	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.		
IV	**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*, Trifluprom azine, 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. **C. Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant action **Barbiturates**: Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas**: Phenacemide, Carbamazepine* **Benzodiazepines**: Clonazepam **Miscellaneous:** Primidone, Valproic acid , Gabapentin, Felbamate	8	4

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
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 (*)			
I	**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.	10	1
II	**Drugs acting on Autonomic Nervous System** **Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution. **Sympathomimetic agents: SAR of Sympathomimetic agents** Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol. **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.	10	2
III	**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.	10	3

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	MEDICINAL CHEMISTRY-I PRACTICAL	II	IV
Course Code	Course Title		Course Type
BP405P	MEDICINAL CHEMISTRY-I PRACTICAL		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	erform synthesis of heterocyclic and medicinally important organic compounds.	Ap
2	Characterize synthesized compounds using melting point and TLC techniques.	Ap
3	Illustrate and interpret reaction mechanisms of organic transformations.	U
4	Apply retrosynthetic and synthetic strategies in multistep synthesis.	An
5	Maintain lab safety, documentation, and reporting in pharmaceutical synthesis.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).CO-

PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

V	**Drugs acting on Central Nervous System** **General 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, Levallorphan tartarate, Naloxone hydrochloride. **Anti-inflammatory agents:** Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	7	5

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHYSICAL PHARMACEUTICS-II	II	IV

Course Code	Course Title	Course Type
BP403T	PHYSICAL PHARMACEUTICS-II	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand physical principles governing drug dosage form design.	Ap
2	Analyze solubility, dissolution, and stability of pharmaceutical systems.	Ap
3	Apply rheological and particle size concepts in formulation.	U
4	Evaluate physicochemical properties affecting drug delivery.	U
5	Perform calculations related to physical pharmacy processes.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS

I- Preparation of drugs/ intermediates

1,3-pyrazole
1,3-oxazole
Benzimidazole
Benztriazole
2,3- diphenyl quinoxaline
Benzocaine
Phenytoin
Phenothiazine
Barbiturate

II- Assay of drugs

Chlorpromazine
Phenobarbitone
Atropine
Ibuprofen
Aspirin
Furosemide

Determination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHYSICAL PHARMACEUTICS-II PRACTICAL	II	IV

Course Code	Course Title	Course Type
BP407P	PHYSICAL PHARMACEUTICS-II PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Determine and interpret particle size distribution using standard techniques.	Ap
2	Measure viscosity, flow properties, and rheological behavior of pharmaceutical formulations.	Ap
3	Evaluate surface and interfacial phenomena in dosage forms (e.g., surface tension, HLB value).	U
4	Conduct experiments to assess complexation, solubility enhancement, and diffusion.	An
5	Apply physical principles in preformulation studies through accurate laboratory experimentation.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	7	1
II	**Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers **Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus	10	2
III	**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.	10	3
IV	**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.	10	4
V	**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	10	5

LIST OF PRACTICALS
1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination sedimentation volume with effect of different suspending agent 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: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHARMACOLOGY-I	II	IV
Course Code	Course Title		Course Type
BP404T	PHARMACOLOGY-I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand pharmacodynamics and pharmacokinetics principles.	Ap
2	Describe drug actions on body systems and receptors.	Ap
3	Analyze therapeutic uses and adverse effects of drugs.	U
4	Interpret preclinical and clinical pharmacology data.	U
5	Apply pharmacology knowledge in rational drug therapy.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHARMACOLOGY-I PRACTICAL	II	IV
Course Code	Course Title		Course Type
BP408P	PHARMACOLOGY-I PRACTICAL		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Demonstrate experimental methods for studying drug effects using simulated or virtual lab models.	Ap
2	Interpret pharmacological data from dose-response curves and screening models.	Ap
3	Explain preclinical safety and toxicity study protocols.	U
4	Apply principles of good laboratory practices and animal ethics in pharmacology experiments.	An
5	Record, analyze, and present pharmacological findings effectively.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	1. **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 .Enzyme induction, enzyme inhibition, kinetics of elimination	8	1
II	**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.	12	2
III	2. 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). e. Local anesthetic agents. f. Drugs used in myasthenia gravis and glaucoma	10	3
IV	**3. 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	8	4
V	**3. Pharmacology of drugs acting on central nervous system** a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. b. Drugs used in Parkinsons disease and Alzheimer's disease. c. CNS stimulants and nootropics. d. Opioid analgesics and antagonists e. Drug addiction, drug abuse, tolerance and dependence.	7	5

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHARMACOGNOSY AND PHYTOCHEMISTRY I	II	IV

Course Code	Course Title	Course Type
BP405T	PHARMACOGNOSY AND PHYTOCHEMISTRY I	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify medicinal plants and their morphological features.	Ap
2	Understand extraction and analysis of phytoconstituents.	Ap
3	Explain pharmacological activities of herbal drugs.	U
4	Apply quality control methods for herbal medicines.	U
5	Demonstrate knowledge of herbal drug standardization.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

LIST OF PRACTICALS
1. Introduction to experimental pharmacology. 2. Commonly used instruments in experimental pharmacology. 3. Study of common laboratory animals. 4. Maintenance of laboratory animals as per CPCSEA guidelines. 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies. 6. Study of different routes of drugs administration in mice/rats. 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice. 8. Effect of drugs on ciliary motility of frog oesophagus 9. Effect of drugs on rabbit eye. 10. Effects of skeletal muscle relaxants using rota-rod apparatus. 11. Effect of drugs on locomotor activity using actophotometer. 12. Anticonvulsant effect of drugs by MES and PTZ method. 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. 14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anesthetics by different methods *Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A.
5. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott
6. Williams & Wilkins
7. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
8. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical
9. Publishers (P) Ltd, New Delhi.
8. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
9. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
10. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
11. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

	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		

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	10	1
II	**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**	10	2
III	**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	7	3
IV	**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	10	4
V	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 chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:	8	5

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

Recommended Books: (Latest Editions)

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
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

Semester-IV

Program	Subject	Year	Semester
B. Pharm.	PHARMACOGNOSY AND PHYTOCHEMISTRY I PRACTICAL	II	IV

Course Code	Course Title	Course Type
BP408P	PHARMACOGNOSY AND PHYTOCHEMISTRY I PRACTICAL	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify and classify crude drugs based on morphology and sensory characteristics.	Ap
2	Perform extraction and isolation of phytoconstituents using standard techniques.	Ap
3	Conduct preliminary phytochemical screening and interpret results.	U
4	Demonstrate techniques for evaluation and standardization of herbal formulations.	An
5	Maintain quality assurance and documentation practices in herbal drug analysis.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
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 (*)			
I	**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*, Phenidamine tartarate, 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, Busalfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin **Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate **Miscellaneous:** Cisplatin, Mitotane.	10	1
II	**Anti-anginal:** **Vasodilators:** Amyl nitrite, 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 Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. 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, Hydralazine hydrochloride.	10	2
III	**Anti-arrhythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride,	10	3

Semester-V

Program	Subject	Year	Semester
B. Pharm.	Medicinal Chemistry II	3	I
Course Code	Course Title		Course Type
BP501T	Medicinal Chemistry II		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand chemical basis of drug action.	Ap
2	Analyze structure-activity relationships of drugs.	Ap
3	Explain synthesis and metabolism of drug molecules.	U
4	Design novel drug candidates using medicinal chemistry principles.	An
5	Apply chemical knowledge in rational drug development.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO-CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	0	3	0	0	2	0	2	2	2	2	3	3	0	0
CO2	3	0	2	3	0	0	0	0	0	2	2	3	3	3	2	0
CO3	3	3	2	0	2	0	0	0	0	2	2	0	3	0	2	2
CO4	3	3	0	3	0	0	2	0	0	2	0	3	3	3	0	0
CO5	3	3	0	3	0	0	2	0	2	2	0	0	3	3	0	0

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-V

Program	Subject	Year	Semester
B. Pharm.	Industrial Pharmacy I	3	I
Course Code	Course Title		Course Type
BP 502 T	Industrial Pharmacy I		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand industrial scale drug production processes.	Ap
2	Apply formulation and packaging techniques for mass production.	Ap
3	Ensure quality control and regulatory compliance in industry.	U
4	Optimize manufacturing parameters for product consistency.	An
5	Demonstrate knowledge of GMP and industrial safety.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO-CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	1	3	2	0	0	2	2	1	3	1	3	2	2	3	0
CO2	2	1	3	2	0	0	2	2	1	3	1	3	2	2	3	1
CO3	2	2	2	3	1	1	2	2	3	3	1	2	2	3	3	2
CO4	2	1	3	3	0	0	2	2	2	3	1	3	2	3	3	1
CO5	2	2	2	2	1	1	2	3	3	3	2	2	2	3	3	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

	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.		
IV	**Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones:** Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for 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.	08	4
V	**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. **Amino Benzoic acid derivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous:** Phenacaine, Diperodon, Dibucaine.*	07	5

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

	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		
V	**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.	10	5

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 parenteral dosage forms and its impact on stability of dosage forms.	07	1
II	**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	10	2
III	**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	08	3
IV	**Parenterals:** 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	10	4

Detailed Syllabus:

LIST OF PRACTICALS
1. Preformulation studies on paracetamol/asparin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tables/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Qulaity control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
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, Marcel Dekker Series, Vol 107.

Semester-V

Program	Subject	Year	Semester
B. Pharm.	Industrial PharmacyI (Practical)	3	I

Course Code	Course Title	Course Type
BP 506 P.	Industrial PharmacyI (Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	--	--	4

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	**Operate and calibrate** key industrial-scale equipment (tablet compression machine, capsule filling unit, fluid-bed dryer, coating pan, etc.) in accordance with standard operating procedures.	Ap
2	**Formulate and manufacture** solid oral dosage forms (granules, tablets, hard-gelatin capsules) on a pilot scale, selecting appropriate excipients and processing parameters to ensure manufacturability.	Ap
3	**Perform in-process and finished-product quality tests**—weight variation, hardness, friability, disintegration, dissolution, content uniformity—and **interpret the data** against pharmacopoeial limits.	U
4	**Validate and optimize** critical process variables (e.g., compression force, coating spray rate, drying temperature) to achieve batch-to-batch consistency using statistical or DoE approaches.	An
5	**Document production, validation, and QC activities** in compliance with Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP), generating accurate batch-manufacturing and analytical records.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

PO-CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	1	2	3	1	0	2	2	2	3	1	3	2	3	3	1
CO2	2	1	3	2	1	0	2	2	1	3	1	3	2	3	3	1
CO3	2	2	2	3	1	0	2	2	2	3	1	2	3	3	3	2
CO4	2	2	3	3	1	0	2	2	2	3	1	2	2	3	3	1
CO5	2	1	2	2	2	1	2	3	3	3	2	2	2	3	3	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	10	1
II	**1. Pharmacology of drugs acting on cardio vascular system** a. Drug used in the therapy of shock. b. Hematinics, coagulants and anticoagulants. c. Fibrinolytics and anti-platelet drugs d. Plasma volume expanders **2. Pharmacology of drugs acting on urinary system** a. Diuretics b. Anti-diuretics.	10	2
III	**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	08	3
IV	**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. d. Insulin, Oral Hypoglycemic agents and glucagon. e. ACTH and corticosteroids.	08	4
V	**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	07	5

Semester-V

Program	Subject	Year	Semester
B. Pharm.	Pharmacology II – Theory	3	I
Course Code	Course Title		Course Type
BP503 T	Pharmacology II – Theory		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand pharmacodynamics and pharmacokinetics principles.	Ap
2	Describe drug actions on body systems and receptors.	Ap
3	Analyze therapeutic uses and adverse effects of drugs.	U
4	Interpret preclinical and clinical pharmacology data.	An
5	Apply pharmacology knowledge in rational drug therapy.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

LIST OF PRACTICALS
1. Introduction to *in-vitro* pharmacology and physiological salt solutions. 2. Effect of drugs on isolated frog heart. 3. Effect of drugs on blood pressure and heart rate of dog. 4. Study of diuretic activity of drugs using rats/mice. 5. DRC of acetylcholine using frog rectus abdominis muscle. 6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively. 7. Bioassay of histamine using guinea pig ileum by matching method. 8. Bioassay of oxytocin using rat uterine horn by interpolation method. 9. Bioassay of serotonin using rat fundus strip by three point bioassay. 10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay. 11. Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method). 12. Determination of PD_2 value using guinea pig ileum. 13. Effect of spasmogens and spasmolytics using rabbit jejunum. 14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model. 15. Analgesic activity of drug using central and peripheral methods *Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*

Books Recommended:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
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 Pointb Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Semester-V

Program	Subject	Year	Semester
B. Pharm.	PHARMACOLOGY-II (Practical)	3	I
Course Code	Course Title		Course Type
BP 507 P	PHARMACOLOGY-II (Practical)		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Demonstrate understanding of basic principles of experimental pharmacology, including ethical aspects and regulatory guidelines for animal use.

Develop skills to handle laboratory animals (rats, mice, frogs) safely and ethically, including restraining, dosing, and observations of pharmacological effects.

Perform and interpret various in-vitro and in-vivo experiments to assess drug actions on the central nervous system (CNS), cardiovascular system (CVS), and autonomic nervous system (ANS) using simulated or actual data.

Determine dose-response relationships and understand the concept of drug potency, efficacy, and antagonism using graphical methods (e.g., cumulative dose-response curves).

Simulate preclinical screening of drugs such as analgesics, anti-inflammatory agents, and muscle relaxants using software tools or observed protocols.

Analyze pharmacological data critically and draw meaningful conclusions about drug effects, mechanisms, and therapeutic potential.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Demonstrate safe handling, dosing, and ethical use of laboratory animals in experiments.	Ap
2	Perform experiments to understand pharmacological effects of drugs on different systems.	Ap
3	Analyze dose-response data and determine potency and efficacy of drugs.	U
4	Simulate preclinical pharmacological screening methods using software or observational data.	An
5	Maintain laboratory notebooks, record observations accurately, and interpret pharmacological results scientifically.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	7	1
II	General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: **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	14	2
III	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	06	3
IV	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	10	4
V	**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.	08	5

Semester-V

Program	Subject	Year	Semester
B. Pharm.	PHARMACOGNOSY AND PHYTOCHEMISTRY II	3	I

Course Code	Course Title	Course Type
BP504 T	PHARMACOGNOSY AND PHYTOCHEMISTRY II	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify medicinal plants and their morphological features.	Ap
2	Understand extraction and analysis of phytoconstituents.	Ap
3	Explain pharmacological activities of herbal drugs.	U
4	Apply quality control methods for herbal medicines.	An
5	Demonstrate knowledge of herbal drug standardization.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

PO-CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	1	1	1	2	2	1	2	2	3	1	0	1	0	2
CO2	3	2	2	3	1	1	2	1	1	2	2	1	0	3	2	0
CO3	3	2	2	2	2	2	2	1	1	3	3	1	3	1	1	2
CO4	3	2	3	3	1	1	2	2	2	3	2	2	1	3	3	1
CO5	3	2	2	3	1	1	2	2	3	3	3	2	1	3	3	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

LIST OF PRACTICALS
1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander 2. Exercise involving isolation & detection of active principles a. Caffeine - from tea dust. b. Diosgenin from Dioscorea c. Atropine from Belladonna d. Sennosides from Senna 3. Separation of sugars by Paper chromatography 4. TLC of herbal extract 5. Distillation of volatile oils and detection of phytoconstitutents by TLC 6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

Books Recommended:

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, 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, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

Semester-V

Program	Subject	Year	Semester
B. Pharm.	PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)	3	I

Course Code	Course Title	Course Type
BP 508 P	PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
Identify important medicinal plants based on their morphological and microscopic characteristics..
Perform extraction of phytoconstituents using appropriate methods.
Demonstrate chromatographic techniques (e.g., TLC) for analysis of herbal extracts.
Understand the preparation and evaluation of herbal formulations.
Apply quality control tests and standardization parameters for herbal drugs.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify and distinguish medicinal plants based on morphological and microscopic characters.	Ap
2	Extract phytoconstituents from herbal drugs using standard laboratory techniques.	Ap
3	Perform chromatographic techniques (e.g., TLC) for qualitative analysis of herbal extracts.	U
4	Prepare and evaluate herbal formulations using standard methods.	An
5	Apply quality control tests and standardization parameters to assess purity and efficacy.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap- Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

PO-CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	2	1	2	2	2	1	2	2	3	2	0	1	0	2
CO2	3	2	3	2	1	1	2	1	1	2	2	2	0	3	2	1
CO3	3	2	3	3	1	1	2	1	1	2	2	2	0	3	3	1
CO4	3	2	3	2	2	2	2	2	2	3	2	2	2	3	3	2
CO5	3	2	3	3	2	1	2	2	3	3	3	2	2	3	3	2

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	10	1
II	**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	10	2
III	**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 Penalities **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 cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties	12	3
IV	**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	08	4

Semester-V

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL JURISPRUDENCE	3	I
Course Code	Course Title		Course Type
BP 505 T	PHARMACEUTICAL JURISPRUDENCE		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand laws and regulations governing pharmacy practice.	Ap
2	Apply drug control acts and ethics in pharmaceutical operations.	Ap
3	Interpret legal requirements for drug manufacture and sale.	U
4	Ensure compliance with intellectual property rights.	An
5	Promote ethical professional conduct in pharmacy.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	MEDICINAL CHEMISTRY – III	3	II
Course Code	Course Title		Course Type
BP601T	MEDICINAL CHEMISTRY – III		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic concepts of drug design including prodrugs, analog design, and combinatorial chemistry.	Ap
2	Explain the chemical structure, classification, and mechanism of action of drugs acting on the central nervous system (CNS).	Ap
3	Describe the structure–activity relationship (SAR) of important drug classes such as antipsychotics, antidepressants, anticonvulsants, and analgesics.	U
4	Outline the synthesis and uses of CNS-acting drugs including general anesthetics, local anesthetics, and sedative–hypnotics.	An
5	Correlate the physicochemical properties of drug molecules with their biological activity and pharmacokinetics for CNS-related drugs.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

	Prevention of Cruelty to animals Act-1960: Objectives, Definitions, Institutional Animal Ethics 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)		
V	**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** D efinition, 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)**	07	5

Recommended books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
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)

	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. **Sulphones :** Dapsone		
V	**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. of combinatorial	07	5

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)			
I	**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	10	1
II	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin. **Prodrugs:** Basic concepts and application of prodrugs design. **Antimalarias:** 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.	10	2
III	**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.	10	3
IV	**Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **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,	08	4

Detailed Syllabus:

LIST OF PRACTICALS
I Preparation of drugs and intermediates 1 Sulphanilamide 2 7-Hydroxy, 4-methyl coumarin 3 Chlorobutanol 4 Triphenyl imidazole 5 Tolbutamide 6 Hexamine **II Assay of drugs** 1 Isonicotinic acid hydrazide 2 Chloroquine 3 Metronidazole 4 Dapsone 5 Chlorpheniramine maleate 6 Benzyl penicillin **III** Preparation of medicinally important compounds or intermediates by Microwave irradiation technique **IV** Drawing structures and reactions using chem draw® **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)

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	MEDICINAL CHEMISTRY – III (Practical)	3	II

Course Code	Course Title	Course Type
BP607P	MEDICINAL CHEMISTRY – III (Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Understand basic laboratory techniques used in the synthesis of CNS-acting drugs and other therapeutic agents.

Perform synthesis of selected pharmaceutical compounds and confirm their identity using preliminary chemical tests.

Interpret and analyze the reaction mechanisms involved in drug synthesis.

Correlate chemical structure with biological activity (SAR) based on practical example

Apply principles of green chemistry and safety measures during chemical synthesis in the laboratory.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Synthesize selected CNS-active pharmaceutical compounds using appropriate chemical methods.	Ap
2	Demonstrate understanding of reaction mechanisms involved in drug synthesis.	Ap
3	Identify and confirm synthesized compounds using chemical tests and interpretation of results.	U
4	Relate chemical structure with pharmacological activity through hands-on SAR-based synthesis.	An
5	Practice safe handling, proper documentation, and ethical conduct during laboratory work.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 **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.	10	1
II	**Chemotherapy** a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides.	10	2
III	**Chemotherapy** a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e. Anthelmentics f. Antimalarial drugs g. Antiamoebic agents	10	3
IV	**Chemotherapy** i Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy. Immunopharmacology a. Immunostimulants b. Immunosuppresants Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	08	4
V	**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, organophosphosphorus compound and lead, mercury and arsenic poisoning. **Chronopharmacology** a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy.	07	5

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	PHARMACOLOGY-III	3	II
Course Code	Course Title		Course Type
BP602 T	PHARMACOLOGY-III		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology.

.Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the pharmacological actions, mechanisms, and adverse effects of drugs acting on the central nervous system (CNS).	Ap
2	Explain the pharmacology of drugs used in the treatment of neurodegenerative and psychiatric disorders.	Ap
3	Discuss the pharmacological basis of drugs used in the treatment of cardiovascular and renal disorders.	U
4	Describe the mechanism of action and therapeutic uses of autacoids and their antagonists.	An
5	Evaluate endocrine pharmacology and the role of hormones and related drugs in disease management.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

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

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	PHARMACOLOGY-III (Practical)	3	II

Course Code	Course Title	Course Type
BP 608 P	PHARMACOLOGY-III (Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Demonstrate experimental methods to evaluate the pharmacological actions of drugs on various organ systems using simulated models.

Understand the mechanism of drug action through in vitro and in vivo models relevant to the central nervous system, cardiovascular system, and autonomic nervous system.

Analyze and interpret dose-response curves (DRCs) and calculate drug potency and efficacy.

Apply principles of bioassay techniques to determine the strength of unknown drug samples.

Familiarize with software-based simulations to replace animal experiments in line with ethical standards (use of software like Ex-Pharma, X-cology, etc.).

Develop ethical and regulatory awareness in handling experimental pharmacology studies in compliance with CPCSEA norms.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Demonstrate experimental techniques to assess drug actions on major physiological systems using simulated models.	Ap
2	Analyze dose-response relationships and evaluate drug potency and efficacy.	Ap
3	Apply bioassay methods for quantification of drug samples.	U
4	Interpret pharmacological data using software-based simulations.	An
5	Recognize the ethical and legal aspects of experimental pharmacology and animal use in research.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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** 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.	11	1
II	**Nutraceuticals** General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various 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.	07	2
III	**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:** 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	10	3
IV	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.	10	4

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	HERBAL DRUG TECHNOLOGY (Theory)	3	II

Course Code	Course Title	Course Type
BP 603 T	HERBAL DRUG TECHNOLOGY (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

.Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic concepts and scope of herbal drug industry and traditional systems of medicine.	Ap
2	Identify, evaluate, and classify crude drugs and their active constituents.	Ap
3	Describe various methods of extraction, purification, and standardization of herbal products..	U
4	Explain the principles of Ayurvedic formulations, polyherbal preparations, and nutraceuticals.	An
5	Apply quality control parameters, regulatory aspects, and good manufacturing practices (GMP) in herbal drug production.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	HERBAL DRUG TECHNOLOGY(Practical)	3	II

Course Code	Course Title	Course Type
BP 609 P	HERBAL DRUG TECHNOLOGY(Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):

Identify and authenticate crude herbal materials through macroscopic, microscopic, and physicochemical examinations.

Carry out extractions of plant constituents using conventional (maceration, Soxhlet) and modern (ultrasound, microwave-assisted) techniques.

Prepare and evaluate polyherbal formulations (e.g., churna, asava–arishta, syrup, ointment) following Ayurvedic and pharmacopeial guidelines.

Apply chromatographic methods (TLC/HPTLC) to develop fingerprint profiles for quality assessment of herbal extracts.

Quantify marker compounds by UV-Vis or HPLC analysis and interpret results against established standards.

Perform quality-control tests—moisture content, ash values, pesticide residue, aflatoxin, and microbial load—on raw drugs and finished products.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Identify and evaluate crude drugs and herbal raw materials based on macroscopic, microscopic, and physical features.	Ap
2	Perform extraction and isolation techniques for herbal active constituents.	Ap
3	Prepare and standardize Ayurvedic/polyherbal formulations using traditional methods and modern guidelines.	U
4	Analyze herbal drugs using chromatographic techniques like TLC/HPTLC for quality assessment.	An
5	Apply quality control and regulatory guidelines (GMP, WHO) in the documentation and standardization of herbal products.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

	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. **Regulatory Issues -** Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.		
V	**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.	07	5

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	BIOPHARMACEUTICS AND PHARMACOKINETICS	3	II

Course Code	Course Title	Course Type
BP 604 T	BIOPHARMACEUTICS AND PHARMACOKINETICS	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO)

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand drug absorption, distribution, metabolism, and excretion.	Ap
2	Analyze factors affecting bioavailability and bioequivalence.	Ap
3	Apply pharmacokinetic models to drug dosing.	U
4	Interpret pharmacokinetic data for clinical applications.	An
5	Optimize drug delivery using biopharmaceutical principles.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

LIST OF PRACTICALS
1. To perform preliminary phytochemical screening of crude drugs. 2. Determination of the alcohol content of Asava and Arista 3. Evaluation of excipients of natural origin 4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation. 5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements. 6. Monograph analysis of herbal drugs from recent Pharmacopoeias 7. Determination of Aldehyde content 8. Determination of Phenol content 9. Determination of total alkaloids

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing ompany,Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 of drugs	10	1
II	**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 **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.	10	2
III	**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	10	3
IV	**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.	08	4
V	**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs	07	5

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescottby ADIS Health Science Press.

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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.	10	1
II	a) Study of cloning vectors, restriction endonucleases and DNA ligase. 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	10	2
III	**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.	10	3
IV	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.	08	4
V	a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. 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.	07	5

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL BIOTECHNOLOGY (Theory)	3	II
Course Code	Course Title		Course Type
BP 605 T	PHARMACEUTICAL BIOTECHNOLOGY (Theory)		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

Biotechnology has a long promise to revolutionize the biological sciences and technology.
Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting.
Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
Biotechnology has already produced transgenic crops and animals and the future promises lot more.
It is basically a research-based subject.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Explain microbial growth, fermentation technology, and their roles in producing biopharmaceuticals.	Ap
2	Describe recombinant-DNA techniques and the industrial production of therapeutic proteins and peptides.	Ap
3	Discuss the development and biomedical applications of monoclonal antibodies, vaccines, and other immunobiologics.	U
4	Analyse bioprocess parameters and perform scale-up calculations for large-scale biopharmaceutical manufacturing.	An
5	Apply biosafety, bioethical, and regulatory guidelines (GMP, GLP, ICH, WHO, NIH) in biotechnology operations.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Semester-VI

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL QUALITY ASSURANCE (Theory)	3	II

Course Code	Course Title	Course Type
BP606 T	PHARMACEUTICAL QUALITY ASSURANCE (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand principles of quality management systems in pharma.	Ap
2	Implement GMP and regulatory compliance strategies.	Ap
3	Conduct audits and quality risk assessments.	U
4	Ensure documentation and validation in pharma operations.	An
5	Promote continuous quality improvement.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
2. RA Goldshy et. al., : Kuby Immunology.
3. J.W. Goding: Monoclonal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	INSTRUMENTAL METHODS OF ANALYSIS (Theory)	4	I

Course Code	Course Title	Course Type
BP701 T	INSTRUMENTAL METHODS OF ANALYSIS (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand principles of spectroscopy, chromatography, and electrochemical analysis.	Ap
2	Apply instrumental techniques for drug identification and quantification.	Ap
3	Interpret analytical data from various instruments.	U
4	Perform routine quality control using instrumental methods.	An
5	Ensure validation and calibration of analytical instruments.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 **NABL accreditation :** Principles and procedures	10	1
II	**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.	10	2
III	**Quality Control:** Quality control test for containers, rubber closures and secondary packing 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	10	3
IV	**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.	08	4
V	**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	07	5

Recommended Books: (Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P P Sharma.
6. ISO 9000 and Total Quality Management – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

	High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.		
V	**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 **Affinity chromatography-** Introduction, theory, instrumentation and applications	07	5

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
II	**IR spectroscopy** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications **Flame Photometry**-Principle, interferences, instrumentation and applications **Atomic absorption spectroscopy-** Principle, interferences, instrumentation and applications **Nepheloturbidometry-** Principle, instrumentation and applications	10	2
III	**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	10	3
IV	**Gas chromatography** - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications	08	4

Detailed Syllabus:

LIST OF PRACTICALS	
1	Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
2	Estimation of dextrose by colorimetry
3	Estimation of sulfanilamide by colorimetry
4	Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
5	Assay of paracetamol by UV- Spectrophotometry
6	Estimation of quinine sulfate by fluorimetry
7	Study of quenching of fluorescence
8	Determination of sodium by flame photometry
9	Determination of potassium by flame photometry
10	Determination of chlorides and sulphates by nephelo turbidometry
11	Separation of amino acids by paper chromatography
12	Separation of sugars by thin layer chromatography
13	Separation of plant pigments by column chromatography
14	Demonstration experiment on HPLC
15	Demonstration experiment on Gas Chromatography

Recommended Books (Latest Editions)

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

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	INSTRUMENTAL METHODS OF ANALYSIS (Practical)	4	I

Course Code	Course Title	Course Type
BP705 P	INSTRUMENTAL METHODS OF ANALYSIS (Practical)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
2	4	--	--

Maximum Marks	CIA	ESE
50	15	35

Learning Objective (LO):
Operate and handle various pharmaceutical analytical instruments like UV, FTIR, flame photometer, etc.
Perform spectroscopic and chromatographic analysis of pharmaceutical substances.
Apply analytical methods to estimate active pharmaceutical ingredients in formulations.
Maintain instruments and ensure calibration and validation procedures.
Interpret and report data with accuracy and precision for quality control.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Demonstrate proficiency in operating UV-Visible, FTIR, and flame photometry instruments.	Ap
2	Analyze pharmaceutical compounds using spectroscopic and chromatographic techniques.	Ap
3	Estimate drugs quantitatively using calibration curves and absorbance data	U
4	Maintain, calibrate, and validate analytical instruments as per standard procedures.	An
5	Record, analyze, and interpret instrumental data for pharmaceutical quality control.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
II	**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, 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	10	2
III	**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.	10	3
IV	**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	08	4
V	**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 Drugs.	07	5

Recommended Books: (Latest Editions)

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

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	INDUSTRIAL PHARMACY II (Theory)	4	I

Course Code	Course Title	Course Type
BP 702 T	INDUSTRIAL PHARMACY II (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	-

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the principles and types of packaging materials used in pharmaceuticals and their regulatory aspects.	Ap
2	Explain the technology involved in the manufacture of cosmetics and pharmaceutical aerosols.	Ap
3	Illustrate the formulation and quality control aspects of surgical and medical products.	U
4	Analyze pilot plant scale-up techniques and technology transfer in pharmaceutical industries.	An
5	Apply industrial safety, hazard management, and plant layout principles in pharmaceutical manufacturing.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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, 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.	10	1
II	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.	10	2

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	PHARMACY PRACTICE (Theory)	4	I

Course Code	Course Title	Course Type
BP 703 T	PHARMACY PRACTICE (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand patient counseling and medication management.	Ap
2	Apply knowledge in dispensing and pharmaceutical care.	Ap
3	Promote rational drug use and adherence.	U
4	Demonstrate awareness of healthcare systems and pharmacy ethics.	An
5	Manage drug information and clinical pharmacy services.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

	c) **Interpretation of Clinical Laboratory Tests** Blood chemistry, hematology, and urinalysis		

Recommended Books (Latest Edition):

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, 1st 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.

Journals:

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

	f) **Community pharmacy management** Financial, materials, staff, and infrastructure requirements.		
III	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 patients.	10	3
IV	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. c) **Over the counter (OTC) sales** Introduction and sale of over the counter, and Rational use of common over the counter medications.	08	4
V	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.	07	5

CO-PO/PSO Mapping for the course:

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

3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

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

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	Practice School (Practical)	4	I
Course Code	Course Title		Course Type
BP706 P	Practice School (Practical)		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
6	4	--	12

Maximum Marks	CIA	ESE
150	25	125

Learning Objective (LO):

By the end of the Practice School, students will be able to:

1. Gain hands-on experience in a professional pharmaceutical or healthcare setting.
2. Apply theoretical knowledge to solve real-world problems in chosen domains (industry, community pharmacy, hospital, research lab, etc.).
3. Develop technical, analytical, and decision-making skills relevant to pharmaceutical sciences.
4. Enhance interpersonal, professional, and communication skills through workplace interaction.
5. Understand regulatory, ethical, and organizational aspects of pharmaceutical practice.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Apply academic knowledge to practical tasks in the pharmaceutical domain through real-time exposure.	Ap
2	Demonstrate problem-solving and critical thinking abilities in handling tasks or projects during the practice school.	Ap
3	Communicate effectively with mentors, team members, and professionals in oral and written formats through reports and presentations.	U
4	Exhibit professionalism, ethics, and responsibility expected in pharmaceutical or healthcare workplaces.	An
5	Reflect on the learning experience and develop insights for future career planning, lifelong learning, and interdisciplinary collaboration.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

Semester-VII

Program	Subject	Year	Semester
B. Pharm.	NOVEL DRUG DELIVERY SYSTEMS (Theory)	4	I

Course Code	Course Title	Course Type
BP 704 T	NOVEL DRUG DELIVERY SYSTEMS (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject is designed to impart basic knowledge on the area of novel drug delivery systems.
Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand design and evaluation of novel delivery systems.	Ap
2	Apply nanotechnology, liposomes, and targeted delivery concepts.	Ap
3	Analyze controlled and sustained release formulations.	U
4	Evaluate regulatory and safety aspects of novel systems.	An
5	Promote innovation in drug delivery for improved therapy.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 exchange 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.	10	1
II	**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 implantsand osmotic pump	10	2
III	**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	10	3
IV	**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications	08	4
V	**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, development of intra uterine devices (IUDs) and applications	07	5

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)	4	II

Course Code	Course Title	Course Type
BP801 T	BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand basic statistical tools for data analysis.	Ap
2	Apply statistical methods to pharmaceutical research.	Ap
3	Design research projects and clinical trials.	U
4	Interpret research data and draw valid conclusions.	An
5	Prepare scientific reports and presentations.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Recommended Books: (Latest Editions)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, 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.

Journals

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

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	SOCIAL AND PREVENTIVE PHARMACY	4	II

Course Code	Course Title	Course Type
BP 802 T	SOCIAL AND PREVENTIVE PHARMACY	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand community health and preventive pharmacy concepts.	Ap
2	Promote health education and disease prevention strategies.	Ap
3	Analyze social factors affecting drug use and health outcomes.	U
4	Implement public health pharmacy programs.	An
5	Advocate ethical and social responsibilities of pharmacists.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
II	**Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples 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	10	2
III	**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.	10	3
IV	Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels **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	08	4
V	**Design and Analysis of experiments:** **Factorial Design:** Definition, 22, 23design. Advantage of factorial design **Response Surface methodology:** Central composite design, Historical design, Optimization Techniques	07	5

Recommended Books: (Latest Editions)

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	PHARMA MARKETING MANAGEMENT (Theory)	4	II
Course Code	Course Title		Course Type
BP803 ET	PHARMA MARKETING MANAGEMENT (Theory)		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand principles of marketing in pharmaceutical industry.	Ap
2	Apply marketing strategies and product lifecycle management.	Ap
3	Analyze market research and consumer behavior.	U
4	Develop skills in sales, distribution, and promotion.	An
5	Manage regulatory and ethical aspects of pharma marketing.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
II	**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	10	2
III	**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, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	10	3
IV	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	08	4
V	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.	07	5

Recommended Books: (Latest Editions)

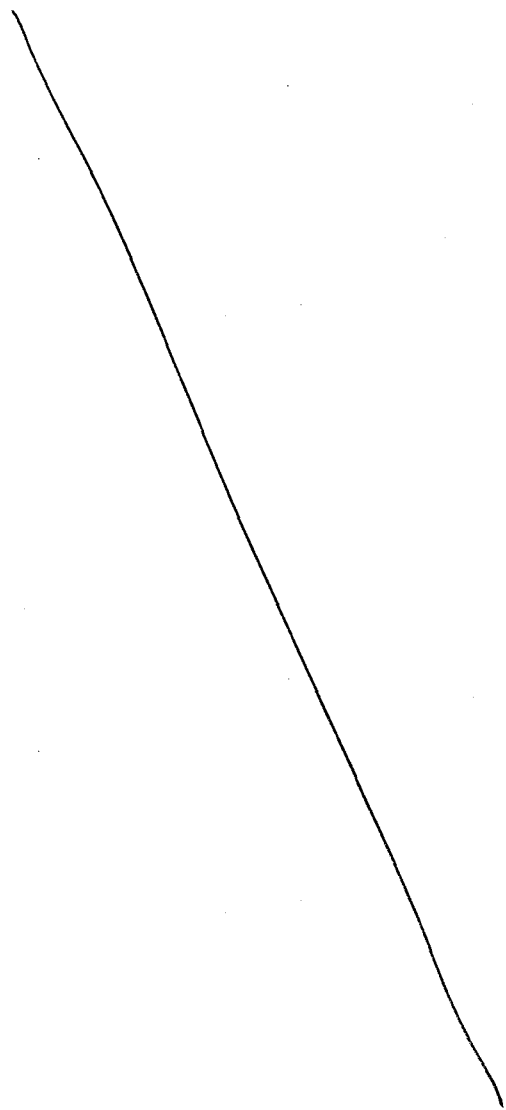
1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEEPublications
3. 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

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)
6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, Indian Context, Macmilan India, New Delhi.
7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi
8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.



Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **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.	10	1
II	**Product decision:** Classification, product line and product mix decisions, product life cycle,product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.	10	2
III	**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.	10	3
IV	**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.	10	4
V	**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; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing.	10	5

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	10	1
II	**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)	10	2
III	**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.	10	3
IV	**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	10	4
V	**Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	10	5

Recommended Books: (Latest Editions)

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
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.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	PHARMACEUTICAL REGULATORY SCIENCE (Theory)	4	II
Course Code	Course Title		Course Type
BP804 ET	PHARMACEUTICAL REGULATORY SCIENCE (Theory)		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand regulatory frameworks for drug approval and marketing.	Ap
2	Apply guidelines for clinical trials and product registration.	Ap
3	Ensure compliance with global regulatory standards.	U
4	Interpret regulatory documentation and labeling requirements.	An
5	Promote pharmacovigilance and post-marketing surveillance.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 Management of adverse drug reactions **Basic terminologies used in pharmacovigilance** Terminologies of adverse medication related events Regulatory terminologies	10	1
II	**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	10	2
III	**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	10	3

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	PHARMACOVIGILANCE (Theory)	4	II
Course Code	Course Title		Course Type
BP 805 T	PHARMACOVIGILANCE (Theory)		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand principles of drug safety monitoring.	Ap
2	Identify and report adverse drug reactions (ADRs).	Ap
3	Analyze data from pharmacovigilance systems.	U
4	Promote safe and rational drug use.	An
5	Implement regulatory requirements for pharmacovigilance.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

12. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn 3=7297
13. http://www.ich.org/
14. http://www.cioms.ch/
15. http://cdsco.nic.in/
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

	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		
IV	**Safety data generation** Pre clinical 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 Post approval expedited reporting Pharmacovigilance planning Good clinical practice in pharmacovigilance studies	08	4
V	**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	07	5

Recommended Books: (Latest Editions)

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers.
7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G. Parthasarathi, Karin NyfortHansen,Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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	10	1
II	**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.	10	2
III	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	10	3
IV	Stability testing of herbal medicines.Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.	08	4
V	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	07	5

Recommended Books: (Latest Editions)

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

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)	4	II

Course Code	Course Title	Course Type
BP 806 ET	QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)	Elective

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand quality parameters for herbal drugs.	Ap
2	Apply pharmacognostic and phytochemical standardization methods.	Ap
3	Perform quality control tests on herbal formulations.	U
4	Ensure compliance with herbal drug regulatory guidelines.	An
5	Promote safe and effective use of herbal medicines.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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	10	1
II	**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.	10	2
III	**Molecular Modeling and virtual screening techniques** **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.	10	3
IV	**Informatics & Methods in drug design** Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	08	4
V	**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.	07	5

Recommended Books: (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
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.

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	COMPUTER AIDED DRUG DESIGN (Theory)	4	II

Course Code	Course Title	Course Type
BP 807 ET	COMPUTER AIDED DRUG DESIGN (Theory)	Elective

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand computational tools in drug discovery.	Ap
2	Apply molecular modeling and docking techniques.	Ap
3	Analyze structure-activity relationships using software.	U
4	Design novel drug candidates using in silico methods.	An
5	Integrate computer-aided approaches in pharmaceutical research.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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)	10	1
II	a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	10	2
III	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	10	3
IV	a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	08	4
V	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	07	5

Recommended Books: (Latest Editions)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.
13. RA Goldshy et. al., : Kuby Immunology.

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	CELL AND MOLECULAR BIOLOGY	4	II
Course Code	Course Title		Course Type
BP808 ET	CELL AND MOLECULAR BIOLOGY		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.

This is done both on a microscopic and molecular level.

Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organismssuch as humans, plants, and sponges.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand cell structure and function at molecular level.	Ap
2	Explain gene expression, replication, and regulation.	Ap
3	Analyze cell signaling and molecular pathways in health and disease.	U
4	Apply molecular biology techniques in pharmaceutical research.	An
5	Correlate molecular biology with drug action mechanisms.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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.	10	1
II	**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-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.	10	2
III	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.	10	3
IV	**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.	08	4
V	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	07	5

Recommended Books: (Latest Editions)

1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	COSMETIC SCIENCE(Theory)	4	II

Course Code	Course Title	Course Type
BP809 ET	COSMETIC SCIENCE(Theory)	Elective

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

Understand the basic concepts of cosmetics including definitions, classifications, and regulatory aspects related to cosmetic products.

Identify ingredients used in cosmetic formulations such as emollients, emulsifiers, preservatives, and surfactants and their functional roles.

Explain the formulation, preparation, and evaluation of cosmetic products such as creams, lotions, shampoos, conditioners, lipsticks, and perfumes.

Apply scientific knowledge in designing cosmetic formulations for skin, hair, oral, and personal hygiene care.

Assess the safety, stability, and quality of cosmetic products as per regulatory guidelines (e.g., BIS, FDA, EU norms).

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand formulation and evaluation of cosmetic products.	Ap
2	Apply knowledge of skin biology and cosmetic ingredients.	Ap
3	Evaluate safety and efficacy of cosmetics.	U
4	Comply with regulatory requirements for cosmetic products.	An
5	Innovate and develop novel cosmetic formulations.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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.	08	1
II	**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 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	10	2
III	**Preclinical screening models**: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	-	3
IV	**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.	-	4
V	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	05	5

Recommended Books: (Latest Editions)

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

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	Experimental Pharmacology	4	II

Course Code	Course Title	Course Type
BP810 ET	Experimental Pharmacology	Elective

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand animal models and experimental design in pharmacology.	Ap
2	Demonstrate techniques for evaluating drug effects in vivo and in vitro.	Ap
3	Analyze experimental data to assess drug efficacy and toxicity.	U
4	Apply ethical guidelines in animal experimentation.	An
5	Interpret pharmacological research findings.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	**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 – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	10	1
II	**Thermal Methods of Analysis:** Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) **X-Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, X-ray Crystallography, rotating crystal technique, single crystal diffraction,powder diffraction, structural elucidation and applications.	10	2
III	**Calibration and validation-**as per ICH and USFDA guidelines **Calibration of following Instruments** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer,Fluorimeter, Flame Photometer, HPLC and GC	10	3
IV	**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	08	4
V	**Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS.	07	5

Recommended Books: (Latest Editions)

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

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	ADVANCED INSTRUMENTATION TECHNIQUES	4	II
Course Code	Course Title		Course Type
BP 811 ET	ADVANCED INSTRUMENTATION TECHNIQUES		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

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

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand advanced analytical instruments and their working principles.	Ap
2	Apply techniques like NMR, Mass Spectrometry, and X-Ray diffraction.	Ap
3	Interpret complex instrumental data for pharmaceutical analysis.	U
4	Use advanced instruments in quality control and research.	An
5	Ensure maintenance and calibration of sophisticated equipment.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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	07	1
II	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, Lacto bacillum 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.	15	2
III	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.	07	3
IV	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 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	10	4
V	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.	06	5

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	DIETARY SUPPLEMENTS AND NUTRACEUTICALS	4	II

Course Code	Course Title	Course Type
BP 812 ET	DIETARY SUPPLEMENTS AND NUTRACEUTICALS	Elective

Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the role of dietary supplements and nutraceuticals in promoting health and preventing diseases.	Ap
2	Explain sources, classification, and health benefits of various nutraceuticals.	Ap
3	Apply knowledge of functional foods and their therapeutic applications.	U
4	Analyze scientific evidence supporting the efficacy and safety of nutraceuticals.	An
5	Evaluate regulatory aspects, labeling requirements, and quality standards of nutraceutical products.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

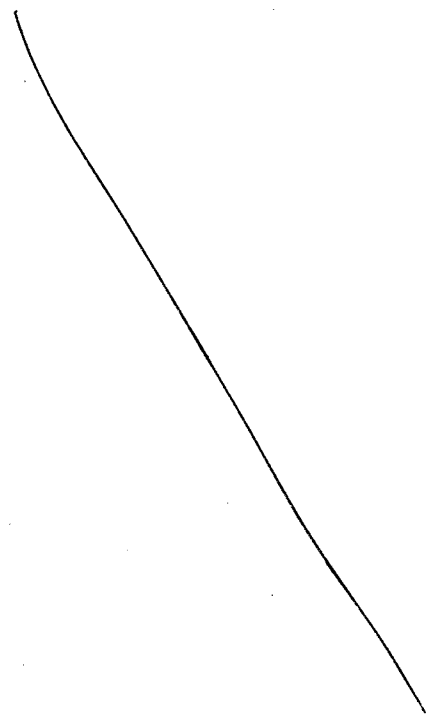
CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

References:

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPunblication.
3. Advanced Nutritional Therapies by Cooper. K.A., (1996).
4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C.williams Editors 2000 Functional foods Woodhead Publ.Co.London.
7. Goldberg, I. Functional Foods. 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.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, M. 1994 Modern Nutrition in Health and Disease. Eighth edition. Lea and Febiger



Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	Pharmaceutical Product Development	4	II
Course Code	Course Title		Course Type
BP 813 ET	Pharmaceutical Product Development		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	--

Maximum Marks	CIA	ESE
100	25	75

Learning Objective (LO):
Understand the principles and stages involved in pharmaceutical product development.
Apply formulation strategies for designing stable, effective, and patient-compliant dosage forms.
Evaluate preformulation and formulation studies, packaging, and scale-up techniques.
Ensure regulatory compliance and quality assurance during product development.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the various stages of pharmaceutical product development including preformulation, formulation, and scale-up.	Ap
2	Apply formulation strategies for development of new dosage forms based on biopharmaceutical and therapeutic considerations.	Ap
3	Evaluate excipients, packaging components, and compatibility studies for product stability.	U
4	Demonstrate knowledge of regulatory, documentation, and quality assurance aspects of pharmaceutical development.	An
5	Integrate knowledge of formulation science, process validation, and legal compliance to ensure successful product launch.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create)

CO-PO/PSO Mapping for the course:

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

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

Unit No.	Topics	No. of Lectures	CO No.
I	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	10	1
II	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a 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	10	2
III	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 specific industrial applications	10	3
IV	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.	08	4
V	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations..	07	5

Recommended Books: (Latest Editions)

1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc.
2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition,Informa Healthcare publishers.
3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman andLeon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013.
5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd.
6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012.
7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40
8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton,3rd Ed.
9. Remington – The Science and Practice of Pharmacy, 20th Ed.

10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman andJoseph B. Schwartz
11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis andH.A. Libermann.
13. Advanced Review Articles related to the topics.

Semester-VIII

Program	Subject	Year	Semester
B. Pharm.	Project Work (Project work)	4	I

Course Code	Course Title	Course Type
BP813PW	Project Work (Project work)	Core

Credit	Hours Per Week (L-T-P)		
	L	T	P
6	4	--	12

Maximum Marks	CIA	ESE
150	0	150

Learning Objective (LO):

By the end of the project work, students will be able to:

1. Explore and apply advanced knowledge related to an elective subject area.
2. Identify a research problem or practical issue and formulate relevant objectives.
3. Develop and execute a methodological plan for data collection, analysis, and interpretation.
4. Enhance skills in teamwork, communication, documentation, and presentation.
5. Understand ethical practices and professional standards in pharmaceutical research and reporting.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Apply specialized knowledge from an elective subject to investigate and solve a pharmaceutical or healthcare-related problem.	Ap
2	Design and execute a mini research/project plan using appropriate scientific methods and tools.	Ap
3	Work collaboratively in a team to achieve project milestones while demonstrating leadership and coordination skills.	U
4	Prepare and present a structured, well-documented project report that reflects analytical thinking and technical writing proficiency.	An
5	Demonstrate professional ethics, research integrity, and readiness for higher studies or employment through project execution and reporting.	U

CL: Cognitive Levels (R-Remember; U-Understanding; Ap-Apply; An-Analyze; E-Evaluate; C-Create).

CO-PO/PSO Mapping for the course:

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

3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

DESCRIPTION
All the students shall undertake a projectunder the supervision of a teacher and submit a report. The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages). The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). Students shall be evaluated in groups for four hours (i.e., about half an hour for a group of five students). The projects shall be evaluated as per the criteria given below