



**Four-Year Undergraduate Programme**

**Bachelor of Pharmacy**

**Faculty of Pharmacy**

**Parul University**

**Vadodara, Gujarat, India**

## ANNEXURE-I

### Faculty of Pharmacy

#### 1. Vision of the Department

To nurture pharmacy aspirants to serve the society with comprehensive subject knowledge, high professional values, excellent skills and out-standing research aptitude.

#### 2. Mission of the Department

**M1** Foster humanitarian values, passion for learning and creativity.

**M2** Move towards high quality, futuristic educational and research ecosystem.

**M3** Develop socially responsible future pharmacists; committed to creating self-reliant India.

#### 3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Pharm curriculum enables graduates to attain.

<b>PEO 1</b>	Acquire the theoretical and practical knowledge of pharmaceutical sciences and apply it in self-practice, hospitals, pharmaceutical industry, academic and research institutions.
<b>PEO 2</b>	Prepare to become leaders of Pharma and health sectors with ethical mindset, effective communication skills, teamwork skills, multidisciplinary approach, and desire to serve the community by creating awareness about healthcare issues.
<b>PEO 3</b>	Acquire the skill to dispense the medication and gain the knowledge for designing a dosage form that address the issues like drug side effects, patient compliance, bioavailability and cost of the medicines.
<b>PEO 4</b>	Able to support the pharmaceutical industries, in their economic development, legal and regulatory prospective of drug approvals at global level and will be able to address social and economic challenges of the country.
<b>PEO 5</b>	Update the knowledge of pharma field facilitated by industrial visits, guest lectures, attending the workshops, seminars and conferences at National and International level.

#### 4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

<b>PLO 1</b>	<b>Pharmacy knowledge:</b>	Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioural, social, and administrative pharmacy sciences; and manufacturing practices.
<b>PLO 2</b>	<b>Planning Abilities:</b>	Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.
<b>PLO 3</b>	<b>Problem analysis: solutions:</b>	Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

<b>PLO 4</b>	<b>Modern tool usage:</b>	Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.
<b>PLO 5</b>	<b>Leadership skills:</b>	Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfilment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and wellbeing.
<b>PLO 6</b>	<b>Professional Identity:</b>	Understand, analyse and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).
<b>PLO 7</b>	<b>Pharmaceutical Ethics:</b>	Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions
<b>PLO 8</b>	<b>Communication:</b>	Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.
<b>PLO 9</b>	<b>The Pharmacist and society:</b>	Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.
<b>PLO 10</b>	<b>Environment and sustainability:</b>	Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
<b>PLO 11</b>	<b>Lifelong learning:</b>	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-Assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

## 5. Program Specific Learning Outcomes

<b>PSO 1</b>	<b>Demand as per recent development</b>	Learn the fundamentals of manufacturing a good quality medication and apply their expertise to develop an effective yet economical pharmaceutical product with commercial advantage and social benefit.
<b>PSO 2</b>	<b>Technical skills</b>	Demonstrate the basic and technical knowledge of drug discovery, herbal drugs, mechanism of drug action, drug structure, and develop their problem-solving skills to become globally qualified pharmacy professionals.

## 6. Credit Framework

Semester wise Credit distribution of the programme

Category wise Credit distribution of the programme

Semester-1	30
Semester-2	29
Semester-3	24
Semester-4	28
Semester-5	26
Semester-6	30
Semester-7	24
Semester-8	22
<b>Total Credits:</b>	<b>213</b>

<b>Category</b>	<b>Credit</b>
Major Core	70
Minor Stream	43
Multidisciplinary	37
Ability Enhancement Course	6
Skill Enhancement Courses	43
Value added Courses	6
Summer Internship	2
Research Project/Dissertation	6
<b>Total Credits:</b>	<b>213</b>

## 7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lecture	Lab	Tut
1	BP101T	Human Anatomy and Physiology I– Theory	4	3		1
2	BP102T	Pharmaceutical Analysis I – Theory	4	3		1
3	BP103T	Pharmaceutics I – Theory	4	3		1
4	BP104T	Pharmaceutical Inorganic Chemistry – Theory	4	3		1
5	BP105T	Communication skills – Theory	2	2	-	
6	BP106RBT	Remedial Biology*	2	2	-	
	BP106RMT	Remedial Mathematics* – Theory				
7	BP107P	Human Anatomy and Physiology – Practical	2		4	
8	BP108P	Pharmaceutical Analysis I – Practical	2		4	
9	BP109P	Pharmaceutics I – Practical	2		4	
10	BP110P	Pharmaceutical Inorganic Chemistry – Practical	2		4	
11	BP111P	Communication skills – Practical	1		2	
12	BP112RBP*	Remedial Biology – Practical	1		2	

<b>Total</b>			<b>30</b>	<b>16</b>	<b>18</b>	<b>4</b>
<b>*Subjects are non-university subjects' credits are given according to council norms</b>						
<b>Semester 2</b>						
<b>Sr. No.</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>Credit</b>	<b>Lecture</b>	<b>Lab</b>	<b>Tut</b>
1	BP201T	Human Anatomy and Physiology II – Theory	4	3		1
2	BP202T	Pharmaceutical Organic Chemistry I – Theory	4	3		1
3	BP203T	Biochemistry – Theory	4	3		1
4	BP204T	Pathophysiology – Theory	4	3		1
5	BP205T	Computer Applications in Pharmacy – Theory	3	3		
6	BP206T	Environmental sciences – Theory	3	3		
7	BP207P	Human Anatomy and Physiology II – Practical	2		4	
8	BP208P	Pharmaceutical Organic Chemistry I – Practical	2		4	
9	BP209P	Biochemistry – Practical	2		4	
10	BP210P	Computer Applications in Pharmacy – Practical	1		2	
<b>Total</b>			<b>29</b>	<b>18</b>	<b>14</b>	<b>4</b>
<b>Subjects are non-university subjects credits are given according to council norms</b>						
<b>Semester 3</b>						
<b>Sr. No.</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>Credit</b>	<b>Lecture</b>	<b>Lab</b>	<b>Tut</b>
1	BP301T	Pharmaceutical Organic Chemistry II – Theory	4	3		1
2	BP302T	Physical Pharmaceutics I – Theory	4	3		1
3	BP303T	Pharmaceutical Microbiology – Theory	4	3		1
4	BP304T	Pharmaceutical Engineering – Theory	4	3		1
5	BP305P	Pharmaceutical Organic Chemistry II – Practical	2		4	
6	BP306P	Physical Pharmaceutics I – Practical	2		4	
7	BP307P	Pharmaceutical Microbiology – Practical	2		4	
8	BP 308P	Pharmaceutical Engineering – Practical	2		4	
<b>Total</b>			<b>24</b>	<b>12</b>	<b>16</b>	<b>4</b>
<b>Semester 4</b>						

Sr. No.	Subject Code	Subject Name	Credit	Lecture	Lab	Tut
1	BP401T	Pharmaceutical Organic Chemistry III– Theory	4	3		1
2	BP402T	Medicinal Chemistry I – Theory	4	3		1
3	BP403T	Physical Pharmaceutics II – Theory	4	3		1
4	BP404T	Pharmacology I – Theory	4	3		1
5	BP405T	Pharmacognosy and Phytochemistry I– Theory	4	3		1
6	BP406P	Medicinal Chemistry I – Practical	2		4	
7	BP407P	Physical Pharmaceutics II – Practical	2		4	
8	BP408P	Pharmacology I – Practical	2		4	
9	BP409P	Pharmacognosy and Phytochemistry I – Practical	2		4	
<b>Total</b>			<b>28</b>	<b>15</b>	<b>20</b>	<b>5</b>
<b>Semester 5</b>						
Sr. No.	Subject Code	Subject Name	Credit	Lecture	Lab	Tut
1	BP501T	Medicinal Chemistry II – Theory	4	3		1
2	BP502T	Industrial Pharmacy-I– Theory	4	3		1
3	BP503T	Pharmacology II – Theory	4	3		1
4	BP504T	Pharmacognosy and Phytochemistry II– Theory	4	3		1
5	BP505T	Pharmaceutical Jurisprudence – Theory	4	3		1
6	BP506P	Industrial Pharmacy-I – Practical	2		4	
7	BP507P	Pharmacology II – Practical	2		4	
8	BP508P	Pharmacognosy and Phytochemistry II – Practical	2		4	
<b>Total</b>			<b>26</b>	<b>15</b>	<b>12</b>	<b>5</b>
<b>Semester 6</b>						
Sr. No.	Subject Code	Subject Name	Credit	Lecture	Lab	Tut
1	BP601T	Medicinal Chemistry III – Theory	4	3		1
2	BP602T	Pharmacology III – Theory	4	3		1
3	BP603T	Herbal Drug Technology – Theory	4	3		1
4	BP604T	Biopharmaceutics and Pharmacokinetics – Theory	4	3		1

5	BP605T	Pharmaceutical Biotechnology – Theory	4	3		1
6	BP606T	Quality Assurance –Theory	4	3		1
7	BP607P	Medicinal chemistry III – Practical	2		4	
8	BP608P	Pharmacology III – Practical	2		4	
9	BP609P	Herbal Drug Technology – Practical	2		4	
<b>Total</b>			<b>30</b>	<b>18</b>	<b>12</b>	<b>5</b>
<b>Semester 7</b>						
<b>Sr. No.</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>Credit</b>	<b>Lecture</b>	<b>Lab</b>	<b>Tut</b>
1	BP701T	Instrumental Methods of Analysis – Theory	4	3		1
2	BP702T	Industrial Pharmacy-II – Theory	4	3		1
3	BP703T	Pharmacy Practice – Theory	4	3		1
4	BP704T	Novel Drug Delivery System – Theory	4	3		1
5	BP705P	Instrumental Methods of Analysis – Practical	2		3	
6	BP706PS	Practice School	6		12	
<b>Total</b>			<b>24</b>	<b>12</b>	<b>15</b>	<b>4</b>
<b>Semester 8</b>						
<b>Sr. No.</b>	<b>Subject Code</b>	<b>Subject Name</b>	<b>Credit</b>	<b>Lecture</b>	<b>Lab</b>	<b>Tut</b>
1	BP801T	Biostatistics and Research Methodology	4	3		1
2	BP802T	Social and Preventive Pharmacy	4	3		1
3	BP803ET	Pharma Marketing Management				
4	BP804ET	Pharmaceutical Regulatory Science				
5	BP805ET	Pharmacovigilance				
6	BP806ET	Quality Control and Standardization of Herbals				
7	BP807ET	Computer Aided Drug Design				
8	BP808ET	Cell and Molecular Biology				
9	BP809ET	Cosmetic Science				
10	BP810ET	Experimental Pharmacology				
11	BP811ET	Advanced Instrumentation Techniques				
12	BP812ET	Dietary Supplements and Nutraceuticals				
13	BP813ET	Pharmaceutical Product Development	8			
14	BP814PW	Project Work	6		12	
<b>Total</b>			<b>22</b>	<b>6</b>	<b>12</b>	<b>2</b>



## 8. Detailed Syllabus

### ANNEXURE-II

#### Semester 1

- a. **Course Name:** Human Anatomy and Physiology I  
b. **Course Code:** BP101T  
c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.  
d. **Rationale:** 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.  
e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the various experiments related to special senses and nervous system.
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Recall and understand the anatomy and physiology of Human body and know the cellular and tissue level organization
<b>CLO 2</b>	Compare and study the anatomy and physiology of skin, skeletal system and joints.
<b>CLO 3</b>	Explain the role and functioning of blood and lymphatic system
<b>CLO 4</b>	Compare and contrast the anatomy and physiology of organs of the cardio vascular system, special senses and peripheral nervous system.
<b>CLO 5</b>	Demonstrate the ability to perform experiments on living issue and normal human beings and also perform the Hematological tests.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Introduction to human body</b> Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.</p> <p><b>Cellular level of organization</b> Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signalling pathway activation by extracellular signal molecule, Forms of intracellular signalling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine</p> <p><b>Tissue level of organization</b> Classification of tissues, structure, location, and functions of epithelial, muscular, and nervous and connective tissues.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Integumentary system</b> Structure and functions of skin</p> <p><b>Skeletal system</b> 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</p> <p><b>Joints</b> Structural and functional classification, types of joints movements and its articulation</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Body fluids and blood</b> Body fluids, composition, and functions of blood, hemopoiesis, formation of haemoglobin, anaemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo-endothelial system.</p> <p><b>Lymphatic system</b> Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Peripheral nervous system:</b> Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.</p>	17.77%	08

	<b>Special senses</b> Structure and functions of eye, ear, nose and tongue and their disorders.		
<b>5</b>	<b>UNIT – V</b>  <b>Cardiovascular system</b> Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

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. Textbook of Medical Physiology- Arthur C, Guyton, and John. E. Hall. Miamisburg, OH, U.S.A.
6. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterjee, Academic Publishers Kolkata

**j. 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. Chatterjee, Academic Publishers Kolkata

**k. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
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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 haemoglobin 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.

- a. **Course Name:** Pharmaceutical Analysis I  
b. **Course Code:** BP102T  
c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.  
d. **Rationale:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.  
e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understanding the principles of volumetric and electro chemical analysis
<b>CLOBJ 2</b>	Carryout various volumetric and electrochemical titrations.
<b>CLOBJ 3</b>	Develop analytical skills

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand analytical techniques, concentration expression methods, and standards differentiation and preparation and standardization of various solutions. To study the overall concept of errors including methods of minimizing errors. Overview of Pharmacopoeia, Impurities and Limit Tests.
<b>CLO 2</b>	Illustrate the principles of Volumetric analysis by performing acid-base titrations, non-aqueous titrations.
<b>CLO 3</b>	Understand of Precipitation Titrations complexometric titrations, Gravimetry and Diazotisation Titration.

<b>CLO 4</b>	Explain Redox titrations and Electrochemical methods.
<b>CLO 5</b>	Develop the analytical skill by performing limit tests and titrations and doing the experiments on preparation, standardization, Assay of certain compounds.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Pharmaceutical analysis-</b> Definition and scope Different techniques of analysis; Methods of expressing concentration; Primary and secondary standards. 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</p> <p><b>Errors:</b> Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures</p> <p><b>Pharmacopoeia:</b> Sources of impurities in medicinal agents, limit tests.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Acid base titration:</b> 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</p> <p><b>Non aqueous titration:</b> Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Precipitation titrations:</b> Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.</p>	22.22%	10

	<p><b>Complexometric titration:</b> Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.</p> <p><b>Gravimetry:</b> Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.</p> <p>Basic Principles, methods and application of diazotisation titration.</p>		
4	<p><b>UNIT – IV</b></p> <p><b>Redox titrations</b>            (a) Concepts of oxidation and reduction            (b) Types of redox titrations (Principles and applications)            Cerimetry, Iodimetry, Iodometry, Bromometry, Dichrometry, Titration with potassium iodate.</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Electrochemical methods of analysis</b>  <b>Conductometry-</b>            Introduction, Conductivity cell, Conductometric titrations, applications.  <b>Potentiometry –</b>            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.  <b>Polarography -</b> Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications</p>	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. John H. Kennedy, Analytical chemistry principles

7. Indian Pharmacopoeia

j. Mapping of Experiment List with Course Learning Outcomes:

Sr. No.	Experiment List
1	To perform the limit test of Chloride
2	To perform the limit test of Sulphate
3	To perform the limit test of Iron
4	To perform the limit test of Arsenic
5	To prepare and standardize Sodium hydroxide
6	To prepare and standardize Sulphuric acid
7	To prepare and standardize Sodium thiosulfate
8	To prepare and standardize Potassium permanganate
9	To prepare and standardize Ceric ammonium sulphate
10	To perform the assay of Ammonium chloride by acid base titration
11	To perform the assay of Ferrous sulphate by Cerimetry
12	To perform the assay of copper sulphate by Iodometry
13	To perform the assay of Calcium gluconate by complexometry
14	To perform the assay of Hydrogen peroxide by Permanganometry
15	To perform the assay of Sodium benzoate by non-aqueous titration
16	To perform the assay of Sodium Chloride by precipitation titration
17	To determine the Normality by Conductometric titration of strong acid against strong base
18	To determine the normality by Conductometric titration of strong acid and weak acid against strong base
19	To determine the normality by Potentiometric titration of strong acid against strong base

- a. **Course Name:** Pharmaceutics-I  
 b. **Course Code:** BP103T  
 c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.  
 d. **Rationale:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the history of profession of pharmacy
<b>CLOBJ 2</b>	Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
<b>CLOBJ 3</b>	Understand the professional way of handling the prescription
<b>CLOBJ 4</b>	Preparation of various conventional dosage forms

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Comprehend the history of the pharmacy profession, Introduction to Dosage form prescription handling and explain posology
<b>CLO 2</b>	Compare and contrast different dosage forms like powders, Liquid dosage forms and pharmaceutical calculations
<b>CLO 3</b>	Demonstrate an understanding of monophasic liquid dosage forms Biphasic liquid dosage forms and pharmaceutical Incompatibilities
<b>CLO 4</b>	Illustrate semisolid dosage forms and suppositories including displacement value calculation
<b>CLO 5</b>	Perform the preparation of various conventional dosage forms

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

## h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Historical background and development of profession of pharmacy:</b> 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.</p> <p><b>Dosage forms:</b> Introduction to dosage forms, classification and definitions</p> <p><b>Prescription:</b> Definition, Parts of prescription, handling of Prescription and Errors in prescription.</p> <p><b>Posology:</b> Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Pharmaceutical calculations:</b> Weights and measures – Imperial &amp; Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.</p> <p><b>Powders:</b> Definition, classification, advantages and disadvantages, Simple &amp; compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.</p> <p><b>Liquid dosage forms:</b> Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Monophasic liquids:</b> Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.</p> <p><b>Biphasic liquids:</b></p> <p><b>Suspensions:</b> Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension &amp; stability problems and methods to overcome.</p> <p><b>Emulsions:</b> Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation &amp; stability problems and methods to overcome.</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Suppositories:</b> Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value &amp; its calculations, evaluation of suppositories.</p>	17.77%	08

	<b>Pharmaceutical incompatibilities:</b> Definition, classification, physical, chemical and therapeutic incompatibilities with examples.		
<b>5</b>	<b>UNIT – V</b> <b>Semisolid dosage forms:</b> 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	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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. Françoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

- a. **Course Name:** Pharmaceutical Inorganic Chemistry  
 b. **Course Code:** BP104T  
 c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.  
 d. **Rationale:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
<b>CLOBJ 2</b>	Understand the medicinal and pharmaceutical importance of inorganic compounds

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the sources of impurities in inorganic Drugs and pharmaceuticals and testing of impurities.
<b>CLO 2</b>	Learn about medicinal and pharmaceutical Importance of acids, bases, buffers, electrolytes and dental products.
<b>CLO 3</b>	Understand the medicinal and pharmaceutical uses of gastrointestinal agents and antimicrobials
<b>CLO 4</b>	Study the inorganic miscellaneous compounds and radiopharmaceuticals.
<b>CLO 5</b>	Demonstrate and explain the practicals on limit tests, identification test, test for purity and preparation of pharmaceutical inorganic compounds.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

	-	4	2			15		35	50
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Impurities in pharmaceutical substances:</b> 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</p> <p><b>General methods of preparation,</b> assay for the compounds superscripted with <b>asterisk</b>, properties and medicinal uses of inorganic compounds belonging to the following classes</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Acids, Bases and Buffers:</b> 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.</p> <p><b>Major extra and intracellular electrolytes:</b> 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.</p> <p><b>Dental products:</b> Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Gastrointestinal agents</b></p> <p><b>Acidifiers:</b> Ammonium chloride and Dil. HCl</p> <p><b>Antacid:</b> Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate, Aluminium hydroxide gel, Magnesium hydroxide mixture</p> <p><b>Cathartics:</b> Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite</p> <p><b>Antimicrobials:</b> Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide, Chlorinated lime, Iodine and its preparations</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Miscellaneous compounds</b></p> <p><b>Expectorants:</b> Potassium iodide, Ammonium chloride.</p>		

	<b>Emetics:</b> Copper sulphate, Sodium potassium tartarate <b>Haematinics:</b> Ferrous sulphate, Ferrous gluconate <b>Poison and Antidote:</b> Sodium thiosulphate, Activated charcoal, Sodium nitrite <b>Astringents:</b> Zinc Sulphate, Potash Alum	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> <b>Radiopharmaceuticals:</b> Radio activity, Measurement of radioactivity, Properties of $\alpha$ , $\beta$ , $\gamma$ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

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, Textbook 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

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	A) To perform the limit test for Chlorides. B) To perform the limit test for Sulphate.
2	To perform the modified limit test for Chlorides and Sulphate.
3	A) To perform the limit test for Iron. B) To perform the limit test for Heavy metals.
4	To perform the limit test for Lead.
5	To perform the limit test for Arsenic.

6	To perform the Identification test for Magnesium Hydroxide.
7	To perform the Identification test for Ferrous Sulphate.
8	To perform the Identification test for Sodium Bicarbonate.
9	To perform the Identification test for Calcium Gluconate.
10	To perform the Identification test for Copper sulphate.
11	To test the Swelling power of Bentonite.
12	To test the Neutralizing capacity of Aluminium hydroxide gel.
13	To carry out the preparation of Boric acid.
14	To carry out the preparation of Potash Alum.
15	To carry out the preparation of the Ferrous Sulphate.

- a. **Course Name:** Communication skills
- b. **Course Code:** BP105T
- c. **Prerequisite:** Students should have effective speaking and writing ability and self-awareness.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the behavioural needs for a pharmacist to function effectively in the areas of pharmaceutical operation
<b>CLOBJ 2</b>	Communicate effectively (Verbal and Non-Verbal)
<b>CLOBJ 3</b>	Effectively manage the team as a team player
<b>CLOBJ 4</b>	Develop interview skills

<b>CLOBJ 5</b>	Develop Leadership qualities and essentials
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basics of Communication skills, the barriers and its perspectives.
<b>CLO 2</b>	Know about the communication style and acquire the knowledge about the elements of communication
<b>CLO 3</b>	Learn the basic Listening and writing Skills
<b>CLO 4</b>	Develop the skills of facing interview, giving presentation and group discussion
<b>CLO 5</b>	Learn the practical aspects of communication skill to develop interview facing ability and leadership qualities.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Communication Skills:</b> Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context</p> <p><b>Barriers to communication:</b> Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers</p> <p><b>Perspectives in Communication:</b> Introduction, Visual Perception, Language, Other factors affecting our</p>	23.33%	07

	perspective - Past Experiences, Prejudices, Feelings, Environment		
<b>2</b>	<b>UNIT – II</b> <b>Elements of Communication:</b> Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication <b>Communication Styles:</b> Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	<b>23.33%</b>	<b>07</b>
<b>3</b>	<b>UNIT – III</b> <b>Basic Listening Skills:</b> Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations <b>Effective Written Communication:</b> Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication <b>Writing Effectively:</b> Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	<b>23.33%</b>	<b>07</b>
<b>4</b>	<b>UNIT – IV</b> <b>Interview Skills:</b> Purpose of an interview, Do's, and Don'ts of an interview <b>Giving Presentations:</b> Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	<b>16.66%</b>	<b>05</b>
<b>5</b>	<b>UNIT – V</b> <b>Group Discussion:</b> Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	<b>13.33%</b>	<b>04</b>
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Textbook and Reference Book:**

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, 5<sup>th</sup> 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, 4<sup>th</sup> Edition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 1999

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To familiar students with different styles of communication skills
2	Understand and practice Interview etiquettes
3	To make students confident of speaking in English
4	To make the students understand the correct way of pronunciation
5	To encourage the students to improve their public speaking
6	To make students become more self-confident and develop strong determination
7	To learn how to overcome the barriers of communication
8	Students learn different techniques of presentation
9	To enhance practical learning to speak by the way of communication starter
10	To encourage the students to cultivate the capacity to accept challenges and manage the impact of adversity
11	To support the students to deliver their presentation that create maximum impact
12	To make the students understand 7cs of communication
13	Students learn different ways & tips for improving interview skills – mock interview
14	To guide students to improve writing skills
15	Learn to communicate and give presentation at a gathering, a broadly applicable professional skill.

- a. **Course Name:** Remedial Biology
- b. **Course Code:** BP106RBT
- c. **Prerequisite:** Students who have opted for Mathematics at their Higher secondary examination and have a combination of Biology/Mathematics or both in addition to Physics, and Chemistry.
- d. **Rationale:** To learn and understand the components of living world, structure and functional system of plant and animal kingdom.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the classification and salient features of five kingdoms of life
<b>CLOBJ 2</b>	Understand the basic components of anatomy & physiology of plant
<b>CLOBJ 3</b>	Know understand the basic components of anatomy & physiology animal with special reference to human

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand and classify living world and morphology of flowering plants
<b>CLO 2</b>	Study of body fluids, their circulation and understanding of functioning of respiratory system
<b>CLO 3</b>	Recall of the anatomy and physiology of human excretory system, nervous system, reproductive system and endocrine glands.
<b>CLO 4</b>	Demonstrate the anatomy & physiology of plants
<b>CLO 5</b>	Identification of plant parts and bones and to learn methods of blood group, blood pressure and tidal volume measurement

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Living world:</b> 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, Protista, Fungi, Animalia and Plantae, Virus,</p> <p><b>Morphology of Flowering plants</b> Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons &amp; Dicotyledons.</p>	23.33%	07
2	<p><b>UNIT – II</b></p> <p><b>Body fluids and circulation</b> 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</p> <p><b>Digestion and Absorption</b> Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food</p> <p><b>Breathing and respiration</b> Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes</p>	23.33%	07
3	<p><b>UNIT – III</b></p> <p><b>Excretory products and their elimination</b> Modes of excretion; Human excretory system- structure and function; Urine formation; Rennin angiotensin system.</p> <p><b>Neural control and coordination</b> 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</p> <p><b>Chemical coordination and regulation</b> Endocrine glands and their secretions Functions of hormones secreted by endocrine glands</p> <p><b>Human reproduction</b> Parts of female reproductive system; parts of male reproductive system; Spermatogenesis and Oogenesis; Menstrual cycle</p>	23.33%	07
4	<b>UNIT – IV</b>		

	<b>Plants and mineral nutrition:</b> Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation <b>Photosynthesis</b> Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	<b>16.66%</b>	<b>05</b>
<b>5</b>	<b>UNIT – V</b>  <b>Plant respiration:</b> Respiration, glycolysis, fermentation (anaerobic). <b>Plant growth and development</b> Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators <b>Cell - The unit of life</b> Structure and functions of cell and cell organelles. Cell division <b>Tissues</b> Definition, types of tissues, location and functions.	<b>13.33%</b>	<b>04</b>
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Textbook and Reference Book:**

1. Textbook of Biology by S. B. Gokhale
2. A Textbook of Biology by Dr. Thulajappa and Dr. Seetaram

**Reference Books**

1. A Textbook of Biology by B.V. Sreenivasa Naidu
2. A Textbook of Biology by Naidu and Murthy
3. Botany for Degree students By A.C. Dutta
4. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan
5. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Introduction to experiments in biology (a) Study of Microscope (b) Section cutting techniques
2	Introduction to experiments in biology (c) Mounting and staining (d) Permanent slide preparation

3	Study of cell and its inclusions
4	Study of Stem, Root, Leaf and their modifications
5	Study of seed, fruit, flower and their modifications
6	Microscopic study and identification of tissues pertinent to Stem
7	Microscopic study and identification of tissues pertinent to Root
8	Microscopic study and identification of tissues pertinent to Leaf
9	Microscopic study and identification of tissues pertinent to Seed
10	Microscopic study and identification of tissues pertinent to fruit and flower
11	Identification of bones
12	Determination of blood group
13	Determination of blood pressure
14	Determination of tidal volume
15	Detailed study of frog by using computer models

- a. **Course Name:** Remedial Mathematics
- b. **Course Code:** BP106RMT
- c. **Prerequisite:** Students who have opted for Biology as their main subject at their Higher secondary examination and have a combination of Biology/Mathematics or both in addition to Physics, and Chemistry
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the theory and their application in Pharmacy
<b>CLOBJ 2</b>	Solve the different types of problems by applying theory
<b>CLOBJ 3</b>	Appreciate the important application of mathematics in Pharmacy

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Solve simple problems associated with functions, Limits, continuity, Logarithms' and partial fractions.
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<b>CLO 2</b>	Apply the appropriate standard form of matrix and solve simple mathematical problems associated with matrix algebra in solving Pharmacokinetic equations
<b>CLO 3</b>	Know about theory and application of calculus in pharmacy
<b>CLO 4</b>	Explains the principles of analytical geometry and Integration
<b>CLO 5</b>	Understand the role of Differential Equations and Laplace Transform in pharmacy.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Partial fraction</b> Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics</p> <p><b>Logarithms</b> Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.</p> <p><b>Function:</b> Real Valued function, Classification of real valued functions,</p> <p><b>Limits and continuity:</b></p>	20 %	06

	Introduction, Limit of a function, Definition of limit of a function.		
2	<p><b>UNIT – II</b></p> <p><b>Matrices and Determinant:</b>  Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer’s rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving, Pharmacokinetic equations</p>	20 %	06
3	<p><b>UNIT – III</b></p> <p><b>Calculus</b>  <b>Differentiation:</b> 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) – <b>Without Proof</b>, Derivative of <math>x^n</math> w.r.t <math>x</math>, where <math>n</math> is any rational number, Derivative of <math>e^x</math>, Derivative of <math>\log_e x</math>, Derivative of <math>ax</math>; Derivative of trigonometric functions from first principles (<b>without Proof</b>), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application</p>	20 %	06
4	<p><b>UNIT – IV</b></p> <p><b>Analytical Geometry</b>  <b>Introduction:</b> Signs of the Coordinates, Distance formula,  <b>Straight Line:</b> 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  <b>Integration:</b>  Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.</p>	20 %	06
5	<p><b>UNIT – V</b></p> <p><b>Differential Equations:</b> Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations,  <b>Application in solving Pharmacokinetic equations</b>  <b>Laplace Transform:</b> Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations,</p>	20 %	06

	<b>Application in solving Chemical kinetics and Pharmacokinetics equations</b>		
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Text Book and Reference Book:**

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 2**

- a. **Course Name:** Human Anatomy and Physiology-II
- b. **Course Code:** BP201T
- c. **Prerequisite:** Students who have background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
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<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the hematological tests like blood cell counts, hemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain the anatomy and physiology of nervous system and describe the digestive system
<b>CLO 2</b>	Describe the anatomy and physiology of respiratory system and energetics
<b>CLO 3</b>	Understand the anatomy and physiology of endocrine system and urinary system
<b>CLO 4</b>	Understand the anatomy and physiology of reproductive system and study of genetics
<b>CLO 5</b>	Demonstrate anatomy and physiology of various organs with the help of models and charts as well as practical understanding of their functions

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Nervous system</b> Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. <b>Central nervous system:</b> Meninges, ventricles of brain and	22.22%	10

	cerebrospinal fluid; structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)		
<b>2</b>	<b>UNIT – II</b>  <b>Digestive system</b> 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. <b>Energetics</b> Formation and role of ATP, Creatinine Phosphate and BMR.	<b>13.33%</b>	<b>6</b>
<b>3</b>	<b>UNIT – III</b>  <b>Respiratory system</b> 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. <b>Urinary system</b> 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.	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT – IV</b>  <b>Endocrine system</b> 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.	<b>22.22%</b>	<b>10</b>
<b>5</b>	<b>UNIT – V</b>  <b>Reproductive system</b> 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 <b>Introduction to genetics</b> Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	<b>20 %</b>	<b>09</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To study the integumentary system 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	To Study the histology of vital organs and gonads with the help of permanent slides.

a. **Course Name:** Pharmaceutical Organic Chemistry-I

b. **Course Code:** BP202T

c. **Prerequisite:** Students should have background of Biology, Physics, and Chemistry.

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Write the structure, name and the type of isomerism of the organic compound
<b>CLOBJ 2</b>	Write the reaction, name the reaction and orientation of reactions
<b>CLOBJ 3</b>	Account for reactivity/stability of compounds,
<b>CLOBJ 4</b>	Identify /confirm the identification of organic compound

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain and classify organic compounds, nomenclature, and structural isomerism of organic compounds, carboxylic acids.
<b>CLO 2</b>	Study of Alkanes, Alkenes and Conjugated Dienes
<b>CLO 3</b>	Explain the Alkyl halides and alcohols, Explain and classify organic compounds
<b>CLO 4</b>	Study of carbonyl compounds, and Aliphatic Amines with reactions.
<b>CLO 5</b>	Identify unknown organic compound Understand qualitative analysis of unknown organic compounds, preparation of solid derivatives, and construction of molecular models

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	

4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Classification, nomenclature and isomerism</b>            Classification of Organic Compounds            Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerism's in organic compounds</p>	15.55%	7
2	<p><b>UNIT – II</b></p> <p><b>Alkanes, Alkenes and Conjugated dienes</b>            SP<sup>3</sup> hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP<sup>2</sup> hybridization in alkenes. E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 versus E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p>SN<sup>1</sup> and SN<sup>2</sup> reactions - kinetics, order of reactivity of alkyl halides, stereochemistry, and rearrangement of carbocations. SN<sup>1</sup> versus SN<sup>2</sup> reactions, Factors affecting SN<sup>1</sup> and SN<sup>2</sup> reactions. Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.  <b>Alcohols</b> - Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Carbonyl compounds (Aldehydes and ketones)</b>            Nucleophilic-addition, electrometric-effect, aldol-condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin</p>	22.22%	10

	condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanillin, Cinnamaldehyde.		
<b>5</b>	<b>UNIT – V</b> <b>Carboxylic acids</b> 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 <b>Aliphatic amines</b> - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	<b>17.77 %</b>	<b>08</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 textbook 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 Ahluwalia/Chatwal.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Introduction to preliminary tests and nature identification of given compounds.
2	To perform element detection Lassigne test of given unknown compounds.

3	To perform solubility test to find out nature of given unknown compounds.
4	To perform functional group identification test for given unknown compounds.
5	Identification of the unknown compound from the literature using melting point/boiling point.
6	Preparation of the derivatives and confirmation of the unknown compound by melting point/boiling point.
7	To identify given unknown organic compound (benzoic acid)
8	To identify given unknown organic compound(acetanilide)
9	To identify given unknown organic compound (cinnamic acid)
10	To identify given unknown organic compound (nitro benzene)
11	To identify given unknown organic compounds(naphthol)
12	Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point (picric acid)
13	Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point (acetyl derivative)
14	Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point (benzamide)
15	To prepare molecular models

- a. **Course Name:** Biochemistry
- b. **Course Code:** BP203T
- c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes
<b>CLOBJ 2</b>	Understand the metabolism of nutrient molecules in physiological and

	pathological conditions.
<b>CLOBJ 3</b>	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study of the biomolecules, bioenergetics and detailed study on enzymes
<b>CLO 2</b>	Understand the biological oxidation and study the metabolism of carbohydrates in physiological and pathological conditions
<b>CLO 3</b>	Explain the metabolism of nutrient molecules like lipids and amino acids in physiological and pathological conditions.
<b>CLO 4</b>	Study of Nucleic acid metabolism and genetic information transfer, the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins
<b>CLO 5</b>	Perform the qualitative and quantitative analysis of biomolecules, factors affecting on enzymes activity, preparation of buffer solution.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Biomolecules</b> Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. <b>Bioenergetics</b> Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy;	15.55%	7

	Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP		
2	<p><b>UNIT – II</b></p> <p><b>Carbohydrate metabolism</b>  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</p> <p><b>Biological oxidation</b>  Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation &amp; its mechanism and substrate Phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Lipid metabolism</b>  <math>\beta</math>-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.</p> <p><b>Amino acid metabolism</b>  General reactions of amino acid metabolism: Transamination, deamination &amp; decarboxylation, urea cycle and its disorders  Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia). Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Nucleic acid metabolism and genetic information transfer</b>  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.</p>	22.22%	10
5	<p><b>UNIT – V</b></p> <p><b>Enzymes</b>  Introduction, properties, nomenclature and IUB classification of enzymes; Enzyme kinetics (Michaelis plot, Line Weaver Burke plot); Enzyme inhibitors with examples;</p>	15.55 %	07

	Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation; Therapeutic and diagnostic applications of enzymes and isoenzymes; Coenzymes –Structure and biochemical functions		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Qualitative Analysis of Carbohydrates (Glucose, Fructose)
2	Qualitative Analysis of Carbohydrates (Lactose, Maltose)
3	Qualitative Analysis of Carbohydrates (Sucrose and Starch)
4	Identification tests for Proteins (Albumin and Casein)
5	Quantitative analysis of reducing Sugars (DNSA method) and Protein (biuret Method)
6	Qualitative analysis of Urine for abnormal Constituents
7	Determination of Blood Creatinine

8	Determination of Blood Sugar
9	Determination of serum total cholesterol
10	Preparation of buffer solution and measurement of pH
11	Study of Enzymatic hydrolysis of Starch
12	Determination of Salivary amylase activity
13	Study the effect of temperature on salivary amylase activity
14	Study the effect of substrate concentration on salivary amylase activity

a. **Course Name:** Pathophysiology

b. **Course Code:** BP204T

c. **Prerequisite:** Students should have a basic understanding of Human anatomy and Physiology, Biology, and Chemistry.

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	1. Describe the etiology and pathogenesis of the selected disease states;
<b>CLOBJ 2</b>	2. Name the signs and symptoms of the diseases; and
<b>CLOBJ 3</b>	3. Mention the complications of the diseases.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Describe the basic pathophysiological mechanisms like cell injury, adaptation, Inflammation and repair.
<b>CLO 2</b>	Explain the etiology, pathophysiology, clinical manifestations and complications of cardiovascular, Respiratory and renal diseases.
<b>CLO 3</b>	Describe the etiology, pathophysiology, clinical manifestations and complications of hematological, endocrinal, nervous and Gastrointestinal system related diseases.
<b>CLO 4</b>	Discuss the etiology pathophysiology, clinical Manifestations and complications of bone and joints and principles of cancer.
<b>CLO 5</b>	Elaborate on the infectious and sexually transmitted diseases.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Basic principles of Cell injury and Adaptation:</b> Introduction, definitions, Homeostasis, Components and Types of Feedback systems, uses 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 &amp; Alkalosis, Electrolyte imbalance</p> <p><b>Basic mechanism involved in the process of inflammation and repair:</b> 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</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Cardiovascular System:</b> Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)</p> <p><b>Respiratory system:</b> Asthma, Chronic obstructive airways diseases.</p> <p><b>Renal system:</b> Acute and chronic renal failure</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Haematological Diseases:</b> Iron deficiency, megaloblastic anaemia (Vit B12 and folic acid), sickle cell anaemia, thalassemia, hereditary acquired anaemia, haemophilia</p>	22.22%	10

	<p><b>Endocrine system:</b> Diabetes, thyroid diseases, disorders of sex hormones</p> <p><b>Nervous system:</b> Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.</p> <p><b>Gastrointestinal system:</b> Peptic Ulcer</p>		
<b>4</b>	<p><b>UNIT – IV</b></p> <p>Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.</p> <p><b>Disease of bones and joints:</b> Rheumatoid arthritis, osteoporosis and gout</p> <p><b>Principles of cancer:</b> classification, etiology and pathogenesis of cancer</p> <p><b>Diseases of bones and joints:</b> Rheumatoid Arthritis, Osteoporosis, Gout</p> <p><b>Principles of Cancer:</b> Classification, etiology and pathogenesis of Cancer</p>	<b>17.77%</b>	<b>8</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p><b>Infectious diseases:</b> Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections</p> <p><b>Sexually transmitted diseases:</b> AIDS, Syphilis, Gonorrhoea</p>	<b>15.55 %</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Computer Applications in Pharmacy
- b. **Course Code:** BP205T
- c. **Prerequisite:** Students should have a basic understanding of Computers.
- d. **Rationale:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various types of application of computers in pharmacy
<b>CLOBJ 2</b>	Know the various types of databases
<b>CLOBJ 3</b>	Know the various applications of databases in pharmacy

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the number system and know the concept of software and information system
<b>CLO 2</b>	Understand the importance of web technologies and programming languages
<b>CLO 3</b>	Learn the applications of computers in pharmacy
<b>CLO 4</b>	Learn Computers as data analysis in Preclinical development and understand the concept of bioinformatics
<b>CLO 5</b>	Perform experiments to understand the practical applicability of computer in pharmacy

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Number system:</b> 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</p> <p><b>Concept of Information Systems and Software:</b> Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project</p>	20 %	06
2	<p><b>UNIT – II</b></p> <p><b>Web technologies:</b> Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database</p>	20 %	06
3	<p><b>UNIT – III</b></p> <p><b>Application of computers in Pharmacy –</b> 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</p>	20 %	06
4	<p><b>UNIT – IV</b></p> <p><b>Bioinformatics:</b> Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.</p>	20 %	06

<b>5</b>	<b>UNIT – V</b> <b>Computers as data analysis in Preclinical development:</b> Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)	<b>20 %</b>	<b>06</b>
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Text Book and Reference Book:**

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

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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 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

- a. **Course Name:** Environmental sciences
- b. **Course Code:** BP206T
- c. **Prerequisite:** Students should have a background in Biology and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Create the awareness about environmental problems among learners.
<b>CLOBJ 2</b>	Impart basic knowledge about the environment and its allied problems.
<b>CLOBJ 3</b>	Develop an attitude of concern for the environment.

<b>CLOBJ 4</b>	Motivate learner to participate in environment protection and environment improvement.
<b>CLOBJ 5</b>	Acquire skills to help the concerned individuals in identifying and solving

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the concept of ecosystem its structure and its functions
<b>CLO 2</b>	Understand the causes, effect and control measures of Environmental pollution
<b>CLO 3</b>	Impart basic knowledge about environment and its allied problems along with the importance of the conservation of natural resources
<b>CLO 4</b>	Gain knowledge on population growth Worldwide and Indian scenario
<b>CLO 5</b>	Make aware of global environmental issues such as climate change, global warming, ozone layer depletion and acid rain.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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.	33.33 %	10
2	<b>UNIT – II</b>		

	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)	33.33 %	10
3	<b>UNIT – III</b> Environmental Pollution: Air pollution; Water pollution; Soil pollution	33.33 %	10
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Textbook and Reference Book:**

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 Publishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clarendon 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.

**Semester 3**

- a. Course Name:** Pharmaceutical Organic Chemistry –II
- b. Course Code:** BP301T
- c. Prerequisite:** Students should have a background in Biology and Chemistry.
- d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know the structure, name and the type of isomerism of the organic compound.
<b>CLOBJ 2</b>	Know the reaction, name the reaction and orientation of reactions.
<b>CLOBJ 3</b>	Understand the account for reactivity/stability of compounds.
<b>CLOBJ 4</b>	Understand the preparation of Organic Compound
<b>CLOBJ 5</b>	Understand the Laboratory Techniques/Oil values/Preparation of Organic Compound.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the concept of aromaticity, structure, Reactions and synthesis of Benzene and its derivatives.
<b>CLO 2</b>	Describe the reactions and synthesis of Phenols, aromatic amines and aromatic acids.
<b>CLO 3</b>	Study of fats and oils, reactivity and their quality control evaluation methods.
<b>CLO 4</b>	Explain the stability and reactions of cycloalkanes, polynuclear hydrocarbons.
<b>CLO 5</b>	Synthesize various aromatic organic compounds and derivatives, determine oil values

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Benzene and its derivatives:</b>		

	<p>A. Analytical, synthetic and other evidence in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule</p> <p>B. Reactions of benzene - nitration, sulphonation, halogenation reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.</p> <p>C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction</p> <p>D. Structure and uses of DDT, Saccharin, BHC and Chloramine</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Phenols</b> - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols</p> <p><b>Aromatic Amines</b> - Basicity of amines, effect of substituents on basicity and synthetic uses of aryl diazonium salts</p> <p><b>Aromatic Acids</b> –Acidity, effect of substituents on acidity and important reactions of benzoic acid.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Fats and Oils</b></p> <p>a) Fatty acids – reactions.</p> <p>b) Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.</p> <p>c) Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Polynuclear hydrocarbons:</b></p> <p>a) Synthesis, reactions</p> <p>b) Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Cyclo-alkanes</b></p> <p>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</p>	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 textbook 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 Ahluwalia/Chatwal.

**j. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	To synthesize m-dinitrobenzene from nitrobenzene.
2	To synthesize acetanilide from aniline.
3	To synthesize p-iodo benzoic acid from benzoic acid.
4	To synthesize benzil from benzoin.
5	To synthesize dibenzal acetone from benzaldehyde (claisen-schamiat reaction).
6	To study about the recrystallization technique for purification of organic compounds.
7	To study about the steam distillation for purification of organic compounds.
8	To determine saponification value of given oil/fat sample.
9	To determine acid value of given oil/fat sample.
10	To determine iodine value of given oil/fat sample.
11	To synthesize benzoic acid from benzyl chloride.
12	To synthesize 1-phenyl 2-azo naphthol from aniline (coupling reaction).
13	To synthesize cinnamic acid from benzaldehyde (Perkin reaction).

14	To synthesize nitro benzene from benzene.
15	To synthesize methyl salicylate from salicylic acid.

**a. Course Name:** Physical Pharmaceutics-I

**b. Course Code:** BP302T

**c. Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.

**d. Rationale:** The course deals with the various physical and physicochemical properties, and principle 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the designing the dosage forms.
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.
<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	Understand the various Pharmaceuticals Equation and formula and application of the same to derive the effective results.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the solubility aspects of the drugs and various principles involved in it.
<b>CLO 2</b>	Explain the different states of matter and understand the basic principles of various physicochemical properties of drug molecules.
<b>CLO 3</b>	Demonstrate the Surface and interfacial phenomenon of liquid formulations and its importance in designing the dosage forms.
<b>CLO 4</b>	Understand the application of complexation and protein binding and study the concept of pH, buffers, isotonic solutions in pharmacy.
<b>CLO 5</b>	Demonstrate the use of physicochemical properties of drug in the formulation development and evaluation of dosage forms.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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	22.22%	10
2	<b>UNIT – II</b> 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	22.22%	10
3	<b>UNIT – III</b> 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,	22.22%	10

	adsorption at solid interface.		
<b>4</b>	<b>UNIT – IV</b> 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.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> 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.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.
5. 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.
6. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
7. Physical Pharmaceutics by C.V.S. Subramanyam
8. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Determination the solubility of benzoic acid at room temperature.

2	Determination the solubility of NaCl at room temperature.
3	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
4	Determination of Partition co- efficient of benzoic acid in benzene and water.
5	Determination of Partition co- efficient of Iodine in CCl <sub>4</sub> and water.
6	Determination of Critical Solution temperature of phenol-water system.
7	Determination of % composition of NaCl in a solution using phenol-water system by CST method.
8	Determination of surface tension of given solution by drop count method.
9	Determination of surface tension of given solution by drop weight method.
10	Determination of HLB number of a surfactant by saponification method.
11	Determination of Freundlich and Langmuir constants using activated char coal.
12	Determination of critical micellar concentration of surfactant (SLS).
13	Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method.
14	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method.
15	Determination of Solubility-Co-Solvency effect

- a. **Course Name:** Pharmaceutical Microbiology
- b. **Course Code:** BP303T
- c. **Prerequisite:** Students should have a background in Biology, Physics, and Chemistry.
- d. **Rationale:** Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand methods of identification, cultivation and preservation of various microorganisms
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<b>CLOBJ 2</b>	Understand the importance and implementation of sterilization in pharmaceutical processing and industry
<b>CLOBJ 3</b>	Learn sterility testing of pharmaceutical products.
<b>CLOBJ 4</b>	Carried out microbiological standardization of Pharmaceuticals.
<b>CLOBJ 5</b>	Understand the cell culture technology and its applications in pharmaceutical industries.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand various aspects of microorganisms, their growth and use of microscopes
<b>CLO 2</b>	Understand the various staining techniques to identify the microorganisms and also study the aspects of sterilization
<b>CLO 3</b>	Learn about the Fungi and Viruses along and summarize the disinfection techniques and sterility testing
<b>CLO 4</b>	Planning an aseptic area, study of spoilage and execute the microbiological standardization of Pharmaceuticals
<b>CLO 5</b>	Carry out the practicals to understand the characteristics of microorganisms and assessing antibiotics using aseptic techniques.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**j. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> 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	22.22%	10

	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 contrast microscopy, dark field microscopy and electron microscopy.		
2	<b>UNIT-II</b> 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.	22.22%	10
3	<b>UNIT-III</b> 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	22.22%	10
4	<b>UNIT-IV</b> 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.	17.77%	08
5	<b>UNIT-V</b> 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	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**k. Textbook and Reference Book:**

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
5. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
6. Pepler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions.
7. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
8. Edward: Fundamentals of Microbiology. 12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
9. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

**1. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
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	Nutrient stabs and slants preparations and Sub culturing of bacteria on nutrient agar slant & stab.
3	Sub culturing of fungus on Sabouraud dextrose agar slant.
4	Study of bacterial morphology by Simple staining method
5	Study of bacterial morphology by Simple negative staining method
6	Study of bacterial morphology by Gram's staining method
7	Study of bacterial morphology by Acid fast staining method
8	Isolation of pure culture of micro-organisms by multiple streak plate technique
9	Microbiological assay of antibiotics by cup plate method.
10	Motility determination by Hanging drop method.

11	Sterility testing of Sterile Water for Injection by direct inoculation method.
12	Sterility testing of Sterile cotton by direct inoculation method.
13	Bacteriological analysis of water

- a. **Course Name:** Pharmaceutical Engineering  
b. **Course Code:** BP 304 T  
c. **Prerequisite:** Students should have a background in Biology, Physics, and Chemistry.  
d. **Rationale:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.  
e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know various unit operations used in Pharmaceutical industries.
<b>CLOBJ 2</b>	To understand the material handling techniques.
<b>CLOBJ 3</b>	To perform various processes involved in pharmaceutical manufacturing process.
<b>CLOBJ 4</b>	To carry out various test to prevent environmental pollution.
<b>CLOBJ 5</b>	To appreciate and comprehend significance of plant lay out design for optimum use of resources.
<b>CLOBJ 6</b>	To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Know about the various unit operations like flow of fluids, size reduction and size separation used in pharmaceutical industries.
<b>CLO 2</b>	Understanding the unit operations like Heat Transfer, Evaporation and Distillation
<b>CLO 3</b>	Demonstration of unit operation like drying and mixing used in pharmaceutical industry.
<b>CLO 4</b>	Gain the knowledge of materials used for pharmaceutical plant construction and understand the processes like filtration and centrifugation.
<b>CLO 5</b>	Demonstrate the practical aspect of various engineering-based unit operations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme		
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Internal Evaluation</b>	<b>ESE</b>	<b>Total</b>

				<b>MSE</b>	<b>CE</b>	<b>P</b>	<b>Theory</b>	<b>P</b>	
<b>3</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>15</b>	<b>10</b>	-	<b>75</b>	-	<b>100</b>
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

<b>Sr. No.</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<p><b>UNIT – I</b></p> <p><b>Flow of fluids:</b> Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi-meter, Pitot tube and Roto-meter.</p> <p><b>Size Reduction:</b> Objectives, Mechanisms &amp; 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 &amp; end runner mill.</p> <p><b>Size Separation:</b> Objectives, applications &amp; 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 &amp; elutriation tank.</p>	<b>22.22%</b>	<b>10</b>
<b>2</b>	<p><b>UNIT – II</b></p> <p>Heat Transfer: Objectives, applications &amp; Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection &amp; radiation. Heat interchangers &amp; heat exchangers.</p> <p><b>Evaporation:</b> 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 &amp; Economy of multiple effect evaporator.</p> <p><b>Distillation:</b> Basic Principles and methodology of simple distillation, flash distillation, fractional distillation,</p>	<b>22.22%</b>	<b>10</b>

	distillation under reduced pressure, steam distillation & molecular distillation		
<b>3</b>	<p><b>UNIT – III</b></p> <p><b>Drying:</b> Objectives, applications &amp; mechanism of drying process, measurements &amp; 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.</p> <p><b>Mixing:</b> Objectives, applications &amp; 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 &amp; Silverson Emulsifier.</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT – IV</b></p> <p><b>Filtration:</b> Objectives, applications, Theories &amp; Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate &amp; frame filter, filter leaf, rotary drum filter, Meta filter &amp; Cartridge filter, membrane filters and Seidtz filter.</p> <p><b>Centrifugation:</b> Objectives, principle &amp; applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge &amp; super centrifuge.</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p><b>Materials of pharmaceutical plant construction, Corrosion and its prevention:</b> 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.</p>	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. Introduction to chemical engineering – Walter L Badger & Julius Banchemo, Latest edition.

2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson Latest edition.
3. Unit operation of chemical engineering – McCabe 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.

j. **Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	To Determine radiation constant of brass, iron, unpainted and painted glass.
2	To perform Steam distillation & to calculate the efficiency of steam distillation.
3	To determine the overall heat transfer coefficient by heat exchanger.
4	To study the drying curve for calcium carbonate & starch.
5	To determine Loss on drying (LOD) and Moisture content of given sample.
6	To determine humidity of air from wet & dry bulb temperature using dew point method.
7	To evaluate particle size distribution of tablet granules using sieving method with construction of various size frequency curve including arithmetic and logarithmic probability plots.
8	To carry out particle size reduction by ball mill and determine Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
9	To demonstrate tablet compression machine, freeze dryer, Fluidized bed dryer, colloid mill & planetary mixer.
10	A) To study the effect of Surface area on rate of filtration.
11	B) To study the effect of filter medium thickness on rate of filtration.
12	To study the effect of viscosity on rate of filtration.

13	To study the effect of concentration on rate of filtration.
14	A) To study the effect of temperature on rate of evaporation.
15	B) To study the effect of Surface area on rate of evaporation.

#### Semester IV

- a. **Course Name:** Pharmaceutical Organic Chemistry-III
- b. **Course Code:** BP401T
- c. **Prerequisite:** Students should have a basic understanding of Organic chemistry-I & II.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the methods of preparation and properties of organic compounds
<b>CLOBJ 2</b>	Explain the stereo chemical aspects of organic compounds and stereo chemical reactions
<b>CLOBJ 3</b>	Know the medicinal uses and other applications of organic compounds

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the nomenclature and definitions of isomers and reactions of chiral molecules
<b>CLO 2</b>	Understand the stereo-chemical aspects of organic compounds
<b>CLO 3</b>	Understand nomenclature & classification, preparation and reaction of certain Heterocyclic compounds
<b>CLO 4</b>	Study the reactions of stereoisomers, synthesis and medicinal use of heterocyclic compounds and their derivatives
<b>CLO 5</b>	Study reactions with importance in synthesis (Name reactions).

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	-	-			-		-	-

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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	22.22%	10
2	<b>UNIT – II</b> Geometrical isomerism: Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems); Methods of determination of configuration of geometrical isomers.	22.22%	10

	Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropoisomeric) and conditions for optical activity. Stereospecific and stereoselective reactions		
<b>3</b>	<b>UNIT – III</b> 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	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT – IV</b> 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	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> Reactions of synthetic importance, Metal hydride reduction (NaBH <sub>4</sub> and LiAlH <sub>4</sub> ), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Medicinal Chemistry-I
- b. **Course Code:** BP402T
- c. **Prerequisite:** Students should have a basic concept of organic and inorganic chemistry.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the chemistry of drugs with respect to their pharmacological activity
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<b>CLOBJ 2</b>	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
<b>CLOBJ 3</b>	Know the Structural Activity Relationship (SAR) of different class of drugs
<b>CLOBJ 4</b>	Write the chemical synthesis of some drugs
<b>CLOBJ 5</b>	Understand the Preparation of drugs/intermediates and perform assay of drugs

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Introduction to medicinal chemistry, Physicochemical properties of drug in relation to biological action and drug metabolism
<b>CLO 2</b>	Explain and classify Drugs acting on Autonomic Nervous System, Structure activity relationship and synthesis of selective drugs.
<b>CLO 3</b>	Study of Cholinergic neurotransmitters, structure-activity relationship and synthesis of selective drugs.
<b>CLO 4</b>	Explain and classify Drugs acting on Central Nervous System, structure activity relationship and synthesis of selective drugs.
<b>CLO 5</b>	Prepare drugs/intermediates, perform assay of drugs and determine partition coefficient.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> Introduction to Medicinal Chemistry History and development of medicinal chemistry Physicochemical properties in relation to biological action	22.22%	10

	<p>Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. Drug metabolism: Drug metabolism principles- Phase I and Phase II.</p> <p>Factors affecting drug metabolism including stereo chemical aspects</p>		
2	<p><b>UNIT – II</b></p> <p>Drugs acting on Autonomic Nervous System</p> <p><b>Adrenergic Neurotransmitters:</b> Biosynthesis and catabolism of catecholamine.</p> <p><b>Adrenergic receptors:</b> (Alpha &amp; Beta) and their distribution.</p> <p><b>Sympathomimetic agents:</b> SAR of Sympathomimetic agents</p> <p>Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. <b>Indirect acting agents:</b> Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol. Adrenergic Antagonists: Alpha adrenergic blockers: Tolazoline, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.</p> <p><b>Beta adrenergic blockers:</b> SAR of beta blockers, Propranolol, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Cholinergic neurotransmitters:</b></p> <p><b>Biosynthesis and catabolism of acetylcholine.</b></p> <p>Cholinergic receptors (Muscarinic &amp; Nicotinic) and their distribution.</p> <p><b>Parasympathomimetic agents:</b> SAR of Parasympathomimetic agents.</p> <p><b>Direct acting agents:</b> Acetylcholine, Carbachol, Bethanechol, Methacholine, Pilocarpine.</p> <p><b>Indirect acting/ Cholinesterase inhibitors</b> (Reversible &amp; Irreversible): Physostigmine, Neostigmine, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorophate, Echothiophate iodide, Parathion, Malathion.</p> <p><b>Cholinesterase reactivator:</b> Pralidoxime chloride.</p> <p><b>Cholinergic Blocking agents:</b> SAR of cholinolytic agents</p> <p>Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide.</p> <p><b>Synthetic cholinergic blocking agents:</b> Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide,</p>	22.22%	10

	Dicyclomine hydrochloride , Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride , Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.		
4	<p><b>UNIT – IV</b></p> <p><b>Drugs acting on Central Nervous System</b></p> <p><b>Sedatives and Hypnotics:</b> Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem</p> <p><b>Barbiturates:</b> SAR of barbiturates, Barbitol, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital.</p> <p><b>Miscellaneous:</b> Amides &amp; imides: Glutethimide; Alcohol &amp; their carbamate derivatives: Meprobamate, Ethchlorvynol; Aldehyde &amp; their derivatives: Triclofos sodium, Paraldehyde. <b>Antipsychotics:</b> Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.</p> <p><b>Fluro-buterphenones:</b> Haloperidol, Droperidol, Risperidone.</p> <p><b>Beta amino ketones:</b> Molindone hydrochloride.</p> <p>Benzamides: Sulpieride.</p> <p><b>Anticonvulsants:</b> SAR of Anticonvulsants, mechanism of anticonvulsant action.</p> <p><b>Barbiturates:</b> Phenobarbitone, Methabarbitol. Hydantoins: Phenytoin , Mephentyoin, Ethotoin Oxazolidine diones: Trimethadione, Paramethadione Succinimides: Phensuximide, Methsuximide, Ethosuximide Urea and monoacylureas: Phenacemide, Carbamazepine Benzodiazepines: Clonazepam.</p> <p><b>Miscellaneous:</b> Primidone, Valproic acid, Gabapentin, Felbamate</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Drugs acting on Central Nervous System</b></p> <p><b>General anesthetics:</b> Inhalation anesthetics: Halothane, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.</p> <p><b>Ultra short acting barbiturates:</b> Methohexital sodium , Thiamylal sodium, Thiopental sodium. Dissociative anaesthetics: Ketamine hydrochloride.</p> <p><b>Narcotic and non-narcotic analgesics:</b> Morphine and related drugs: SAR of Morphine analogues, Morphine</p>	15.55%	07

<p>sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate , Methadone hydrochloride , Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.</p> <p><b>Narcotic antagonists:</b> Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.</p> <p><b>Anti-inflammatory agents:</b> Sodium salicylate, Aspirin, Mefenamic acid , Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen , Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.</p>		
<b>Total</b>	<b>100%</b>	<b>45</b>

i. **Text Book and Reference Book:**

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.

j. **Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	To prepare and submit Barbituric acid from diethyl malonate.
2	To prepare and submit Phenytoin from Benzoin.
3	To prepare and submit Benzocaine from PABA.
4	To prepare and submit Phenothiazine.
5	To prepare and submit 2, 3-diphenylquinoxaline
6	To prepare and submit Benzotriazole.
7	To prepare and submit benzimidazole.
8	To carry out the assay of Ibuprofen

9	To carry out the assay of Aspirin powder
10	To carry out the assay of Phenobarbitone Sodium
11	To carry out the assay of Chlorpromazine
12	To carry out the assay of Frusemide
13	To carry out the assay of Atropine Sulphate
14	To determine the partition coefficient for distribution of Phenyl butazone between octanol and water.
15	To determine the partition coefficient for distribution of Iodine between CCl <sub>4</sub> and water.

- a. **Course Name:** Physical Pharmaceutics II
- b. **Course Code:** BP403T
- c. **Prerequisite:** Students should have a basic understanding of Dosage forms and its formulation.
- d. **Rationale:** The course deals with the various physical and physicochemical properties, and principle's 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the designing the dosage forms
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations
<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	To understand the practical aspects of physico chemical properties in dosage form design.

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Compare properties, formulate, and evaluate coarse and colloidal dispersions
<b>CLO 2</b>	Illustrate the concept of Rheology and contrast the deformation of solids
<b>CLO 3</b>	Classify micromeritic properties of drug molecules in development and characterization of dosage forms.
<b>CLO 4</b>	Explain the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
<b>CLO 5</b>	Practical aspects of physico chemical properties in dosage form design.

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Colloidal dispersions:</b> Classification of dispersed systems &amp; their general characteristics, size &amp; shapes of colloidal particles, classification of colloids &amp; comparative account of their general properties. Optical, kinetic &amp; electrical properties. Effect of electrolytes, coacervation, peptization &amp; protective action.</p>	22.22 %	10
2	<p><b>UNIT – II</b></p> <p><b>Rheology:</b> Newtonian systems, law of flow, kinematic viscosity, effect of temperature, on-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers</p> <p><b>Deformation of solids:</b> Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus</p>	22.22 %	10
3	<p><b>UNIT – III</b></p> <p><b>Coarse dispersion:</b> 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.</p>	22.22 %	10
4	<b>UNIT – IV</b>		

	<b>Micromeritics:</b> 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.	<b>17.77 %</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> 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	<b>15.55 %</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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	Determination of angle of repose of given powder and study effect of particle size on it.
5	Determination of influence of lubricant on angle of repose
6	Determination of viscosity of liquid using Ostwald's viscometer
7	Determination of sedimentation volume with effect of different suspending agent
8	Determination of sedimentation volume with effect of different concentration of a single suspending agent
9	Determination of viscosity of semisolid by using Brook field viscometer
10	Determination of reaction rate constant first order
11	Determination of reaction rate constant second order
12	Accelerated stability studies
13	Preparation and physical stability evaluation of sulphur colloid
14	Determination of globule size of emulsion and to determine type of emulsion using suitable method.
15	Determination of particle size, particle size distribution using sieving method

**a. Course Name:** Pharmacology-I

**b. Course Code:** BP404T

**c. Prerequisite:** Students should have a background in Biology, Human Anatomy & Physiology and chemistry.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the pharmacological actions of different categories of drugs
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<b>CLOBJ 2</b>	Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
<b>CLOBJ 3</b>	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases
<b>CLOBJ 4</b>	Observe the effect of drugs on animals by simulated experiments
<b>CLOBJ 5</b>	Appreciate correlation of pharmacology with other bio medical sciences

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacology and pharmacokinetics
<b>CLO 2</b>	Understand the pharmacological actions of drugs acting on Autonomic Nervous System, Structure activity relationship and illustrate synthesis of selective drugs.
<b>CLO 3</b>	Understand the pharmacology of drugs acting on peripheral nervous system
<b>CLO 4</b>	Explain the treatments of various neurodegenerative and psychological diseases of central nervous system.
<b>CLO 5</b>	Study of the basics of pharmacological experiments, ethics, and observe the effect of drugs on animals by simulated experiments

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	2	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>General Pharmacology</b> <b>Introduction to Pharmacology-</b> Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and	17.77%	08

	<p>noncompetitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.</p> <p><b>Pharmacokinetics-</b> Membrane transport, absorption, distribution, metabolism, and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination</p>		
<b>2</b>	<p><b>UNIT – II</b></p> <p><b>General Pharmacology</b></p> <p><b>Pharmacodynamics-</b> 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.</p> <p><b>Adverse drug reactions.</b></p> <p><b>Drug interactions</b> (pharmacokinetic and pharmacodynamic)</p> <p><b>Drug discovery and clinical evaluation of new drugs</b> -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.</p>	<b>26.67%</b>	<b>12</b>
<b>3</b>	<p><b>UNIT – III</b></p> <p><b>Pharmacology of drugs acting on peripheral nervous system</b></p> <p>Organization and function of ANS. Neurohumoral transmission-transmission and classification of neurotransmitters. Parasympathomimetic, Parasympatholytic, Sympathomimetics, sympatholytic. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anaesthetic agents. Drugs used in myasthenia gravis and glaucoma</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT – IV</b></p> <p><b>Pharmacology of drugs acting on central nervous system</b></p> <p>Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and preanesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics; Alcohols and disulfiram.</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p><b>Pharmacology of drugs acting on central nervous system</b></p>	<b>15.55%</b>	<b>07</b>

	Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinsons disease and Alzheimer’s disease. CNS stimulants and nootropics. Opioid analgesics and antagonists. Drug addiction, drug abuse, tolerance and dependence.		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale’s Pharmacology, Churchill 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
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. VallabhPrakashan,

**j. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	Introduction to experimental pharmacology.

2	Study of commonly used instruments in experimental pharmacology.
3	Study of common laboratory animals.
4	To study the Maintenance of laboratory animals as per CPCSEA guidelines.
5	Study of Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics 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	To study the effect of drugs on ciliary motility of frog oesophagus
9	To study the effect of drugs on rabbit eye.
10	To study the effects of skeletal muscle relaxants using rota-rod apparatus.
11	To study the effect of drugs on locomotor activity using Actophotometer.
12	To study the 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 anaesthetics by different methods

- a. **Course Name:** Pharmacognosy and Phytochemistry-I
- b. **Course Code:** BP405T
- c. **Prerequisite:** Students should have a basic concept of Botany, Biology and Chemistry.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know the techniques in the cultivation and production of crude drugs
<b>CLOBJ 2</b>	To know the crude drugs, their uses and chemical nature
<b>CLOBJ 3</b>	Know the evaluation techniques for the herbal drugs
<b>CLOBJ 4</b>	To carry out the microscopic and morphological evaluation of crude drugs

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacognosy and quality control parameters of herbal drugs
<b>CLO 2</b>	Make use of the techniques in the cultivation, collection, processing, and storage of herbal drugs
<b>CLO 3</b>	Extend the knowledge of plant tissue culture and study of biological source, chemical nature and uses of drugs of natural origin
<b>CLO 4</b>	Develop the pharmacogenetic profile of plant metabolites and role of pharmacognosy in various systems of medicine
<b>CLO 5</b>	Carry out the experiments on the microscopic and morphological characteristics of crude drugs

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Introduction to Pharmacognosy:</b>                      (a) Definition, history, scope and development of Pharmacognosy                      (b) Sources of Drugs – Plants, Animals, Marine &amp; Tissue culture                      (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).  <b>Classification of drugs:</b> Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and serotaxonomical classification of drugs.  <b>Quality control of Drugs of Natural Origin:</b> 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, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida</p>	22.22%	10
2	<p><b>UNIT – II</b>  <b>Cultivation, Collection, Processing and storage of drugs of natural origin:</b>                      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</p>	22.22%	10
3	<p><b>UNIT – III</b>  <b>Plant tissue culture:</b> Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines</p>	15.55%	07
4	<p><b>UNIT – IV</b>  <b>Pharmacognosy in various systems of medicine:</b>                      Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy</p>	22.22%	10

	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		
<b>5</b>	<b>UNIT – V</b> <b>Study of biological source, chemical nature, and uses of drugs of natural origin containing following drugs</b> <b>Plant Products:</b> <b>Fibers</b> - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens <b>Primary metabolites:</b> 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: <b>Carbohydrates:</b> Acacia, Agar, Tragacanth, Honey, Proteins and Enzymes: Gelatine, casein, proteolytic enzymes (Papain, bromelain, serrati peptidase, urokinase, streptokinase, pepsin). Lipids (Waxes, fats, fixed oils): Castor oil, Chaulmoogra oil, Wool Fat, Beeswax <b>Marine Drugs:</b> Novel medicinal agents from marine sources	<b>17.77%</b>	<b>08</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988
3. Textbook of Pharmacognosy by T.E. Wallis.
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Textbook 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.

j. **Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii) Agar (iv) starch (v) Honey
2	Analysis of crude drugs by chemical tests: (i) Gelatin (ii) Castor oil
3	Determination of size of starch grains by eye piece micrometer
4	Determination of Ash value
5	Determination of Fiber length and width
6	Determination of moisture content of crude drugs
7	Determination of Extractive values of crude drugs
8	Determination of swelling index.
9	Determination of foaming index
10	Determination of number of starch grains by Lycopodium spore method
11	Determination of stomatal number and index.
12	Determination of vein islet number.
13	Determination of vein termination
14	Determination of palisade ratio.
15	Determination of size of calcium oxalate crystals by eye piece micrometer.

## Semester 5

- a. **Course Name:** Medicinal chemistry-II
- b. **Course Code:** BP501T
- c. **Prerequisite:** Students should have the basic knowledge of Pharmaceutical Organic Chemistry and Pharmacology
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the chemistry of drugs with respect to their pharmacological activity
<b>CLOBJ 2</b>	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
<b>CLOBJ 3</b>	Know the Structural Activity Relationship of different class of drugs
<b>CLOBJ 4</b>	Study the chemical synthesis of selected drugs

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study of the chemistry of Antihistaminic and Anti-neoplastic agents along with the classification and SAR and synthesis of selective drugs.
<b>CLO 2</b>	Describe the chemistry of Anti-anginal, Diuretics and Anti-hypertensive agents along with the classification and SAR and synthesis of selective drugs.
<b>CLO 3</b>	Understand the chemistry of the drugs used in cardiovascular diseases along with the classification and SAR and synthesis of selective drugs.
<b>CLO 4</b>	Explain the chemistry of the drugs acting on Endocrine system along with the classification and SAR and synthesis of selective drugs.
<b>CLO 5</b>	Explain the chemistry of Antidiabetic agents, local anesthetics and outline other miscellaneous drugs along with the SAR and synthesis of selective drugs.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1	<p><b>UNIT- I</b></p> <p><b>Antihistaminic agents:</b> Histamine, receptors and their distribution in the human body</p> <p><b>H1-antagonists:</b> Diphenhydramine hydrochloride, Dimenhydrinate, Doxylamines succinate, Clemastine fumarate, Diphenylphthaline 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.</p> <p><b>H2-antagonists:</b> Cimetidine, Famotidine, Ranitidin.</p> <p><b>Gastric Proton pump inhibitors:</b> Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole</p> <p><b>Anti-neoplastic agents:</b></p> <p><b>Alkylating agents:</b> Meclroethamine, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa</p> <p><b>Antimetabolites:</b> Mercaptopurine, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate, Azathioprine</p> <p><b>Antibiotics:</b> Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin</p> <p><b>Plant products:</b> Etoposide, Vinblastin sulphate, Vincristin sulphate</p> <p><b>Miscellaneous:</b> Cisplatin, Mitotane.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Anti-anginal:</b></p> <p><b>Vasodilators:</b> Amyl nitrite, Nitroglycerin, Pentaerythritol tetranitrate, Isosorbide dinitrite, Dipyridamole.</p> <p><b>Calcium channel blockers:</b> Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.</p> <p><b>Diuretics:</b></p> <p>Carbonic anhydrase inhibitors: Acetazolamide, Methazolamide, Dichlorphenamide.</p> <p>Thiazides: Chlorthiazide, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,</p> <p>Loop diuretics: Furosemide, Bumetanide, Ethacrynic acid.</p> <p>Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol</p> <p><b>Anti-hypertensive Agents:</b> Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.</p>	22.22%	10
3	<p><b>UNIT- III</b></p> <p><b>Anti-arrhythmic Drugs:</b> Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate, Phenytoin sodium,</p>	22.22%	10

	<p>Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.</p> <p><b>Anti-hyperlipidemic agents:</b> Clofibrate, Lovastatin, Cholesteramine and Cholestipol</p> <p><b>Coagulant &amp; Anticoagulants:</b> Menadione, Acetomenadione, Warfarin, Anisindione, clopidogrel</p> <p><b>Drugs used in Congestive Heart Failure:</b> Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.</p>		
4	<p><b>UNIT- IV</b></p> <p><b>Drugs acting on Endocrine system</b></p> <p>Nomenclature, Stereochemistry and metabolism of steroids</p> <p><b>Sex hormones:</b> Testosterone, Nandralone, Progesterones, Oestriol, Oestradiol, Oestrone, Diethyl stilbestrol.</p> <p><b>Drugs for erectile dysfunction:</b> Sildenafil, Tadalafil.</p> <p><b>Oral contraceptives:</b> Mifepristone, Norgestrel, Levonorgestrol</p> <p><b>Corticosteroids:</b> Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone</p> <p><b>Thyroid and antithyroid drugs:</b> L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.</p>	17.77%	8
	<p><b>UNIT – V</b></p> <p><b>Antidiabetic agents:</b></p> <p>Insulin and its preparations, Sulfonyl ureas: Tolbutamide, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acarbose, Voglibose.</p> <p><b>Local Anesthetics:</b> SAR of Local anesthetics</p> <p><b>Benzoic Acid derivatives;</b> Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.</p> <p><b>Amino Benzoic acid derivatives:</b> Benzocaine, Butamben, Procaine, Butacaine, Propoxycaine, Tetracaine, Benoxinate.</p> <p><b>Lidocaine/Anilide derivatives:</b> Lignocaine, Mepivacaine, Prilocaine, Etidocaine.</p> <p><b>Miscellaneous:</b> Phenacaine, Dipredon, Dibucaine.</p>	15.55	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I. Vogel.

**a. Course Name:** Industrial Pharmacy-I

**b. Course Code:** BP502T

**c. Prerequisite:** Students should have the basic knowledge of pharmaceutical science of dosage forms.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various pharmaceutical dosage forms and their manufacturing techniques.
<b>CLOBJ 2</b>	Know various considerations in development of pharmaceutical dosage forms
<b>CLOBJ 3</b>	Formulate solid, liquid and semisolid dosage forms and evaluate them for their

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the physicochemical characteristics of drug substances and classify the considerations in development of tablets
<b>CLO 2</b>	Study and compare considerations in development of Liquid orals, Capsules and pellets
<b>CLO 3</b>	Outline various considerations in development of Parenteral Products and Ophthalmic Preparations
<b>CLO 4</b>	Know and demonstrate various considerations in development of cosmetics and Pharmaceutical Aerosols and understand the Packaging Materials Science
<b>CLO 5</b>	Prepare and evaluate pharmaceutical dosage forms

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Preformulation Studies:</b> Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. <b>a. Physical properties:</b> Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism <b>b. Chemical Properties:</b> 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.	15.55%	7
2	<b>UNIT-II</b> <b>Tablets:</b> 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 <b>Liquid orals:</b> Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia	22.22%	10
3	<b>UNIT-III</b> <b>Capsules:</b> a. <b>Hard gelatine capsules:</b> Introduction, Production of hard gelatine capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatine capsules,	17.77%	8

	<p>manufacturing defects. In process and final product quality control tests for capsules.</p> <p>b. <b>Soft gelatine capsules:</b> 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 gelatine capsules and their applications.</p> <p><b>Pellets:</b> Introduction, formulation requirements, palletisation process, Equipments for manufacture of pellets</p>		
4	<p><b>UNIT- IV</b></p> <p><b>Parenteral Products:</b></p> <p>a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity</p> <p>b. Production procedure, production facilities and controls, aseptic processing</p> <p>c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.</p> <p>d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.</p> <p><b>Ophthalmic Preparations:</b> Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations</p>	22.22%	10
5	<p><b>UNIT – V</b></p> <p><b>Cosmetics:</b> Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.</p> <p><b>Pharmaceutical Aerosols:</b> Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.</p> <p><b>Packaging Materials Science:</b> 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. <b>Miscellaneous:</b> Phenacaine, Dipiperodon, Dibucaine.</p>	22.22%	10
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To carryout Preformulation studies on Paracetamol/ Aspirin.
2	To demonstrate the Tablet Compression Machine.
3	To prepare and evaluate Aspirin tablets by Direct compression method.
4	To perform Preformulation studies on tableting mixture prepared by Wet granulation.
5	To prepare and evaluate Paracetamol tablets wet granulation.
6	To prepare and evaluate Paracetamol tablets by dry granulation.
7	To carryout Coating of tablets- film coating of tables/granules.
8	To prepare and evaluate Tetracycline capsules.
9	To prepare and evaluate Calcium Gluconate injection.
10	To prepare and evaluate Ascorbic Acid injection.
11	To carryout Quality control tests (as per IP) of marketed tablets and capsules.
12	To prepare and evaluate Eye drops and Eye ointment.
13	To prepare and evaluate Cold Creams.
14	To prepare and evaluate Vanishing cream.

- a. **Course Name:** Pharmacology-II
- b. **Course Code:** BP503T
- c. **Prerequisite:** students should have the basic knowledge of anatomy and physiology and chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting directly on the cardiovascular system
<b>CLO 2</b>	Compare the pharmacology of the drugs acting indirectly on the cardiovascular and urinary system
<b>CLO 3</b>	Explain the pharmacology of autocooids and related drugs.
<b>CLO 4</b>	Illustrate the pharmacology of drugs acting on the endocrine system and study of the basic concept of bioassay.
<b>CLO 5</b>	Demonstrate the effect of various drugs on isolated tissues preparation and on whole animals by stimulated experiments.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>1. Pharmacology of drugs acting on cardio vascular system</b> a. Introduction to hemodynamic and electrophysiology of heart. b. Drugs used in congestive heart failure	22.22%	10

	<ul style="list-style-type: none"> <li>c. Anti-hypertensive drugs.</li> <li>d. Anti-anginal drugs.</li> <li>e. Anti-arrhythmic drugs.</li> <li>f. Anti-hyperlipidemic drugs.</li> </ul>		
2	<b>UNIT-II</b> <b>1. Pharmacology of drugs acting on cardio vascular system</b> <ul style="list-style-type: none"> <li>a. Drug used in the therapy of shock.</li> <li>b. Hematinics, coagulants and anticoagulants.</li> <li>c. Fibrinolytics and anti-platelet drugs</li> <li>d. Plasma volume expanders</li> </ul> <b>2. Pharmacology of drugs acting on urinary system</b> <ul style="list-style-type: none"> <li>a. Diuretics</li> <li>b. Anti-diuretics.</li> </ul>	22.22%	10
3	<b>UNIT-III</b> <b>3. Autocoids and related drugs</b> <ul style="list-style-type: none"> <li>a. Introduction to autacoids and classification</li> <li>b. Histamine, 5-HT and their antagonists.</li> <li>c. Prostaglandins, Thromboxanes and Leukotrienes.</li> <li>d. Angiotensin, Bradykinin and Substance P.</li> <li>e. Non-steroidal anti-inflammatory agents</li> <li>f. Anti-gout drugs</li> <li>g. Antirheumatic drugs</li> </ul>	22.22%	10
4	<b>UNIT- IV</b> <b>5. Pharmacology of drugs acting on endocrine system</b> <ul style="list-style-type: none"> <li>a. Basic concepts in endocrine pharmacology.</li> <li>b. Anterior Pituitary hormones- analogues and their inhibitors.</li> <li>c. Thyroid hormones- analogues and their inhibitors.</li> <li>d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.</li> <li>d. Insulin, Oral Hypoglycemic agents and glucagon.</li> <li>e. ACTH and corticosteroids lyophilized products.</li> <li>d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.</li> </ul> <b>Ophthalmic Preparations:</b> Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations	17.77%	8
5	<b>UNIT-V</b> <b>5. Pharmacology of drugs acting on endocrine system</b> <ul style="list-style-type: none"> <li>a. Androgens and Anabolic steroids.</li> <li>b. Estrogens, progesterone and oral contraceptives.</li> <li>c. Drugs acting on the uterus.</li> </ul> <b>6. Bioassay</b> <ul style="list-style-type: none"> <li>a. Principles and applications of bioassay.</li> <li>b. Types of bioassay</li> <li>c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT</li> </ul>	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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
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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Introduction to experimental pharmacology.
2	Study of commonly used instruments in experimental pharmacology.
3	Study of common laboratory animals.
4	To study the Maintenance of laboratory animals as per CPCSEA guidelines.
5	Study of Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics 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	To study the effect of drugs on ciliary motility of frog oesophagus
9	To study the effect of drugs on rabbit eye.

10	To study the effects of skeletal muscle relaxants using rota-rod apparatus.
11	To study the effect of drugs on locomotor activity using Actophotometer.
12	To study the 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 anaesthetics by different methods

- a. **Course Name:** Pharmacognosy and Phytochemistry- II
- b. **Course Code:** BP504T
- c. **Prerequisite:** students should have the basic knowledge of Botany and Chemistry
- d. **Rationale:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites is 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
<b>CLOBJ 2</b>	To understand the herbal drug interactions
<b>CLOBJ 3</b>	To understand the preparation and development of herbal formulation.
<b>CLOBJ 4</b>	To carryout isolation and identification of phytoconstituents

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Identify the basic metabolic pathways and study the basics of Phytochemistry
<b>CLO 2</b>	Summarise and understand the pharmacognostic profile of Secondary plant metabolites and their commercial applications.
<b>CLO 3</b>	Develop the isolation, identification, utilization, and estimation of phytoconstituents.
<b>CLO 4</b>	Learn the modern extraction methods, spectroscopic and chromatographic techniques for crude drugs

<b>CLO 5</b>	Make use of the practical aspects of identification, isolation, and analysis of crude drugs.
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**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Metabolic pathways in higher plants and their determination</b> 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.	15.55%	7
2	<b>UNIT-II</b> General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites: <b>Alkaloids:</b> Vinca, Rauwolfia, Belladonna, Opium, <b>Phenylpropanoids and Flavonoids:</b> Lignans, Tea, Ruta <b>Steroids, Cardiac Glycosides &amp; Triterpenoids:</b> Liquorice, Dioscorea, Digitalis <b>Volatile oils:</b> Mentha, Clove, Cinnamon, Fennel, Coriander, <b>Tannins:</b> Catechu, Pterocarpus <b>Resins:</b> Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony <b>Glycosides:</b> Senna, Aloes, Bitter Almond <b>Iridoids, Other terpenoids &amp; Naphthaquinones:</b> Gentian, Artemisia, taxus, carotenoids	31.11%	14
3	<b>UNIT-III</b> Isolation, Identification and Analysis of Phytoconstituents a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrrhetic acid & Rutin	13.33%	6

	c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine d) Resins: Podophyllotoxin, Curcumin		
4	<b>UNIT-IV</b> Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	17.77%	8
5	<b>UNIT-V</b> <b>Basics of Phytochemistry</b> Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	15.55%	7
	<b>Total</b>	<b>100</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & 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), 1st Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, 2nd 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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	Morphology, histology and powder characteristics & extraction & detection of:
2	Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
3	Exercise involving isolation & detection of active principles
4	a. Caffeine - from tea dust.
5	b. Diosgenin from Dioscorea
6	c. Atropine from Belladonna
7	d. Sennosides from Senna
8	Separation of sugars by Paper chromatography TLC of herbal extract
9	Distillation of volatile oils and detection of phytoconstituents by TLC

- a. **Course Name:** Pharmaceutical Jurisprudence
- b. **Course Code:** BP505T
- c. **Prerequisite:** Students should have the basic knowledge on important legislations
- d. **Rationale:** This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
<b>CLOBJ 2</b>	Various Indian pharmaceutical Acts and Laws
<b>CLOBJ 3</b>	The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLOBJ 4</b>	The code of ethics during the pharmaceutical practice

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the Drugs and Cosmetics Act, 1940 and its rules 1945 with specific emphasis on Import, Manufacture of drugs and Conditions for grant of license
<b>CLO 2</b>	Study the Drugs and Cosmetics Act, 1940 and its rules 1945 with specific emphasis on schedules, Labeling & Packing of drugs, Administration of the Act and Rules
<b>CLO 3</b>	Gain the knowledge of various Indian pharmaceutical Acts and Laws along with offences and penalties
<b>CLO 4</b>	Study the features of Drugs and Magic Remedies Act and Prevention of Cruelty to animals Act-1960 and also the details of national pharmaceutical authority
<b>CLO 5</b>	Describe the pharmaceutical legislations and IPR and Code of Pharmaceutical ethics during the pharmaceutical practice

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
.			

1	<p><b>UNIT-I</b>  <b>Drugs and Cosmetics Act, 1940 and its rules 1945:</b>  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.</p>	22.22%	10
2	<p><b>UNIT-II</b>  Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F &amp; DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties. Labeling &amp; 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</p>	22.22%	10
3	<p><b>UNIT-III</b>  <b>Pharmacy Act –1948:</b> Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties  <b>Medicinal and Toilet Preparation Act –1955:</b> Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent &amp; Proprietary Preparations. Offences and Penalties.  <b>Narcotic Drugs and Psychotropic substances Act-1985 and Rules:</b> Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic &amp; 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</p>	22.22%	10
4	<p><b>UNIT-IV</b>  <b>Study of Salient Features of Drugs and Magic Remedies Act and its rules:</b> Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties  <b>Prevention of Cruelty to animals Act-1960:</b> 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  <b>National Pharmaceutical Pricing Authority:</b> 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)</p>	17.77%	8

5	<b>UNIT-V</b> <b>Pharmaceutical Legislations</b> – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee <b>Code of Pharmaceutical ethics</b> Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath <b>Medical Termination of Pregnancy Act</b> <b>Right to Information Act</b> <b>Introduction to Intellectual Property Rights (IPR)</b>	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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)

## Semester 6

- a. **Course Name:** Medicinal chemistry-III
- b. **Course Code:** BP601T
- c. **Prerequisite:** Students should have the basic knowledge of anatomy physiology and organic chemistry
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the importance of drug design and different techniques of drug design.
<b>CLOBJ 2</b>	Understand the chemistry of drugs with respect to their biological activity.
<b>CLOBJ 3</b>	Know the metabolism, adverse effects and therapeutic value of drugs.
<b>CLOBJ 4</b>	Know the importance of SAR of drugs.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain history, nomenclature, stereochemistry chemical degradation, classification and SAR of $\beta$ -Lactam, Aminoglycosides and Tetracyclines antibiotics
<b>CLO 2</b>	Study the MOA, classification of Macrolide, Antimalarials and miscellaneous drugs with the SAR, synthesis of selective drugs and prodrug concept
<b>CLO 3</b>	Describe the MOA, classification of Anti-tubercular, UTI, anti-infective and Antiviral agents with the SAR and synthesis of selective drugs.
<b>CLO 4</b>	Study the details of Antifungal, Anthelmintics, Sulphonamides and Sulfones and other antimicrobial agents with the SAR and synthesis of selective drugs. Also understand the basic concept of drug design and combinatorial chemistry.
<b>CLO 5</b>	Synthesize drugs and intermediates, perform assay and determine the physicochemical properties of drugs by using drug design software

g. **Teaching & Examination Scheme:**

<b>Teaching Scheme</b>	<b>Evaluation Scheme</b>
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L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Antibiotics</b> Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. <b>β-Lactam antibiotics:</b> Penicillin, Cephalosporins, β-Lactamase inhibitors, Monobactams <b>Aminoglycosides:</b> Streptomycin, Neomycin, Kanamycin <b>Tetracyclines:</b> Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline	22.22%	10
2	<b>UNIT – II</b> <b>Antibiotics</b> Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. <b>Macrolide:</b> Erythromycin, Clarithromycin, Azithromycin. <b>Miscellaneous:</b> Chloramphenicol, Clindamycin. <b>Prodrugs:</b> Basic concepts and application of prodrugs design. <b>Antimalarials:</b> Etiology of malaria. <b>Quinolines:</b> SAR, Quinine sulphate, Chloroquine, Amodiaquine, Primaquine phosphate, Pamaquine, Quinacrine hydrochloride, Mefloquine. <b>Biguanides and dihydro triazines:</b> Cycloguanil pamoate, Proguanil. <b>Miscellaneous:</b> Pyrimethamine, Artesunate, Artemether, Atovaquone	22.22%	10
3	<b>UNIT – III</b> <b>Anti-tubercular Agents</b> <b>Synthetic anti tubercular agents:</b> Isoniazid, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid. <b>Anti tubercular antibiotics:</b> Rifampicin, Rifabutin, Cycloserine	22.22%	10

	Streptomycine, Capreomycin sulphate. <b>Urinary tract anti-infective agents</b> <b>Quinolones:</b> SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin <b>Miscellaneous:</b> Furazolidine, Nitrofurantoin, Methanamine. <b>Antiviral agents:</b> Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.		
4	<b>UNIT- IV</b> <b>Antifungal agents:</b> <b>Antifungal antibiotics:</b> Amphotericin-B, Nystatin, Natamycin, Griseofulvin. <b>Synthetic Antifungal agents:</b> Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate. <b>Anti-protozoal Agents:</b> Metronidazole, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. <b>Anthelmintics:</b> Diethylcarbamazine citrate, Thiabendazole, Mebendazole, Albendazole, Niclosamide, Oxamniquine, Praziquantel, Ivermectin. <b>Sulphonamides and Sulfones</b> Historical development, chemistry, classification and SAR of <b>Sulfonamides:</b> Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide, Sulphapyridine, Sulfamethoxazole, Sulphadiazine, Mefenide acetate, Sulfasalazine. <b>Folate reductase inhibitors:</b> Trimethoprim, Cotrimoxazole. <b>Sulfones:</b> Dapsone.	17.77%	8
5	<b>UNIT – V</b> <b>Introduction to Drug Design</b> Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. <b>Combinatorial Chemistry:</b> Concept and applications chemistry: solid phase and solution phase synthesis	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 Marcel Dekker Series, Vol 107.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To synthesize Sulphanilamide (P-Aminobenzene Sulphonamide)
2	To Synthesize and submit 7-hydroxy coumarin from resorcinol.
3	Synthesis of Chlorobutanol (1, 1, 1-Trichloro-2-Methyl-2-Propanol)
4	To prepare and submit 2, 4, 5-Triphenylimidazole.
5	To prepare and submit hexamine from formaldehyde
6	To carry out the assay of Isoniazid
7	To carry out the assay of Assay of Chloroquine
8	To carry out the assay of Metronidazole
9	To carry out the assay dapsone
10	To carry out the assay chlorpheniramine
11	To carry out the assay of benzyl penicillin
12	Synthesis of tetrahydro pyrimidine derivative by Microwave assisted technique (Biginelli condensation)
13	Synthesis of Phenytoin from Benzil by Microwave assisted technique
14	To draw chemical structure and reaction schemes using ChemDraw software.
15	To determine physicochemical and druglikness using free online drug design web services.

- a. **Course Name:** Pharmacology-III
- b. **Course Code:** BP602T
- c. **Prerequisite:** Students should have the basic knowledge of anatomy physiology and chemistry
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
<b>CLOBJ 2</b>	Comprehend the principles of toxicology and treatment of various poisonings
<b>CLOBJ 3</b>	Appreciate correlation of pharmacology with related medical sciences.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting on respiratory system and gastrointestinal tract system.
<b>CLO 2</b>	Compare the principles of chemotherapy and study of the mechanism of action of antibiotics
<b>CLO 3</b>	Demonstrate the pharmacology of various chemotherapeutic agents.
<b>CLO 4</b>	Illustrate pharmacology of drugs acting on immune system and learn the principles of toxicology and chrono pharmacology

<b>CLO 5</b>	Practicality understand the pyrogen testing, conduct toxicity studies and apply biostatistics.
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**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>1. Pharmacology of drugs acting on Respiratory system</b> a. Anti -asthmatic drugs b. Drugs used in the management of COPD c. Expectorants and antitussives d. Nasal decongestants e. Respiratory stimulants  <b>2. Pharmacology of drugs acting on the Gastrointestinal Tract</b> a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants. d. Digestants and carminatives. e. Emetics and anti-emetics.	22.22%	10
2	<b>UNIT – II</b> <b>3. Chemotherapy</b> a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides	22.22%	10

3	<b>UNIT- III</b> <b>3. Chemotherapy</b> a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e. Anthelmintics f. Antimalarial drugs g. Antiamoebic agents	22.22%	10
4	<b>UNIT – IV</b> <b>3. Chemotherapy</b> l. Urinary tract infections and sexually transmitted diseases. m. Chemotherapy of malignancy. <b>4. Immunopharmacology</b> a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	17.77%	8
5	<b>UNIT – V</b> <b>5. Principles of toxicology</b> 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, organophosphorus compound and lead, mercury and arsenic poisoning. <b>6. Chrono pharmacology</b> a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy.	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill 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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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)

- a. **Course Name:** Herbal Drug Technology
- b. **Course Code:** BP603T

- c. **Prerequisite:** Students should have the basic knowledge of Pharmacognosy and technology.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand raw material as source of herbal drugs from cultivation to herbal drug product
<b>CLOBJ 2</b>	Know the WHO and ICH guidelines for evaluation of herbal drugs
<b>CLOBJ 3</b>	Know the herbal cosmetics, natural sweeteners, nutraceuticals
<b>CLOBJ 4</b>	Appreciate patenting of herbal drugs, GMP.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Make a use of raw material as source of herbal drugs from cultivation to herbal drug product & ISM formulations.
<b>CLO 2</b>	Learn the general aspects of herbal industry, Schedule T, Nutraceuticals & know about the interaction of herbs with drugs and food.
<b>CLO 3</b>	Demonstrate the Natural excipients & herbal formulations.
<b>CLO 4</b>	Apply the WHO & ICH guidelines for the evaluation of herbal drugs, Indian patenting and regulatory requirements.
<b>CLO 5</b>	Construct the practical knowledge of determination of plant Metabolites and preparation & standardization of herbal formulations.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Herbs as raw materials</b>            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</p> <p><b>Biodynamic Agriculture</b>            Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.</p> <p><b>Indian Systems of Medicine</b>            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.</p>	24.44%	11
2	<p><b>UNIT – II</b></p> <p><b>Nutraceuticals</b>            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</p> <p><b>Herbal-Drug and Herb-Food Interactions:</b> General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper &amp; Ephedra.</p>	15.55%	7
3	<p><b>UNIT- III</b></p> <p><b>Herbal Cosmetics</b>            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.</p> <p><b>Herbal excipients:</b>            Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors &amp; perfumes.</p> <p><b>Herbal formulations :</b>            Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes</p>	22.22%	10
4	<p><b>UNIT- IV</b></p> <p><b>Evaluation of Drugs</b> WHO &amp; ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.</p> <p><b>Patenting and Regulatory requirements of natural products:</b>            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 &amp; Neem.</p> <p><b>Regulatory Issues</b> - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs &amp; Cosmetics Act for ASU drugs.</p>	22.22%	10

5	<b>UNIT – V</b> <b>General Introduction to Herbal Industry</b> 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. <b>Schedule T – Good Manufacturing Practice of Indian systems of medicine</b> Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and records	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**j. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	To perform preliminary phytochemical screening of crude drugs (Drugs containing Alkaloids, Tannin, Resin).
2	To perform preliminary phytochemical screening of crude drugs (Drugs containing Glycosides, Volatile).
3	Determination of the alcohol content of Asava and Arista.
4	Evaluation of excipients of natural origin (Acacia, Agar, Tragacanth, Gelatin, Guar gum).
5	Incorporation of extract in cosmetic formulation - cream and its evaluation.
6	Incorporation of extract in cosmetic formulation - lotion and its evaluation.
7	Incorporation of extract in cosmetic formulation - shampoo and its evaluation.

8	Incorporation of extract in syrup and its evaluation as per Pharmacopoeial requirements..
9	Incorporation of extract in mixture and its evaluation as per Pharmacopoeial requirements..
10	Incorporation of extract in tablet and its evaluation as per Pharmacopoeial requirements..
11	Monograph analysis of herbal drug (Amla) from recent Pharmacopoeias (IP).
12	Monograph analysis of herbal drug (Turmeric) from recent Pharmacopoeias (IP).
13	Determination of Aldehyde content.
14	Determination of Phenol content.
14	Determination of total alkaloids.
15	To perform preliminary phytochemical screening of crude drugs (Drugs containing Alkaloids, Tannin, Resin).

a. **Course Name:** Biopharmaceutics and Pharmacokinetics

b. **Course Code:** BP604T

c. **Prerequisite:** Students should have the basic knowledge of pharmaceutics and pharmacology.

d. **Rationale:** 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 raised therein.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
<b>CLOBJ 2</b>	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
<b>CLOBJ 3</b>	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
<b>CLOBJ 4</b>	Understand various pharmacokinetic parameters, their significance & applications.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study the biopharmaceutics of drug. Absorption and its mechanism.
<b>CLO 2</b>	Understand the biopharmaceutics of drug distribution, metabolism, excretion, and elimination.
<b>CLO 3</b>	Demonstrate an understanding of the concepts of bioavailability and bioequivalence of drug products and their significance.
<b>CLO 4</b>	Explain the concept of pharmacokinetics. and do the calculations of one compartment- open model.

<b>CLO 5</b>	Illustrate the knowledge of the basic concepts of multi-compartment modelling and non-linearity in Pharmacokinetics of the drug and apply the pharmacokinetic principles.
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**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Introduction Biopharmaceutics</b> <b>To Absorption;</b> Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non per oral extra-vascular routes, <b>Distribution</b> 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	22.22%	10
2	<b>UNIT – II</b> <b>Elimination:</b> 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 <b>Bioavailability and Bioequivalence:</b> Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, <i>in-vitro</i> drug dissolution models, <i>in-vitro-in-vivo</i> correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	22.22%	10
3	<b>UNIT- III</b> <b>Pharmacokinetics:</b> Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion	22.22%	10

	and (c) Extra vascular administrations. Pharmacokinetics parameters - $KE$ , $t_{1/2}$ , $V_d$ , $AUC$ , $K_a$ , $Cl_t$ and $CLR$ - definitions methods of eliminations, understanding of their significance and application		
4	<b>UNIT- IV</b> <b>Multicompartment models:</b> Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.	17.77%	8
5	<b>UNIT – V</b> <b>Nonlinear Pharmacokinetics:</b> a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 International edition. USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmkar and Sunil B. Jaiswal, Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Gibaldi Donald, R. Merceel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
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 Company, Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Robert F Notari Marcel Dekker Inc, New York and

Basel, 1987.

12. Remington's Pharmaceutical Sciences, By Mack Publishing Company,  
Pennsylvania

- a. **Course Name:** Pharmaceutical Biotechnology
- b. **Course Code:** BP605T
- c. **Prerequisite:** students should have the basic knowledge of microbiology and biochemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
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<b>CLOBJ 2</b>	Genetic engineering applications in relation to production of pharmaceuticals
<b>CLOBJ 3</b>	Importance of Monoclonal antibodies in Industries
<b>CLOBJ 4</b>	Appreciate the use of microorganisms in fermentation technology

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Illustrate the role of enzyme biotechnology and microbes in protein engineering, emphasizing biosensors applications.
<b>CLO 2</b>	Explain the importance of rDNA technology in genetic engineering in relation to production of biopharmaceuticals, demonstrate the role of cloning vectors, and PCR technology,
<b>CLO 3</b>	Show the immunity and its effect on body after infection. Gain the knowledge of preparation, standardization, and storage of vaccines. Recognize importance of hybridoma techniques and explain blood products
<b>CLO 4</b>	Outline the blotting techniques, emphasizing the importance of microbial genetics, the basics of Mutation, microbial biotransformation, and its applications.
<b>CLO 5</b>	Design of fermenters and its different types, demonstrate the production of pharmaceuticals by fermentation techniques, and illustrate the collection and processing of blood products.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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.	22.22%	10

	<p>d) Brief introduction to Protein Engineering.</p> <p>e) Use of microbes in industry. Production of Enzymes- General consideration -Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.</p> <p>f) Basic principles of genetic engineering.</p>		
<b>2</b>	<p><b>UNIT – II</b></p> <p>a) Study of cloning vectors, restriction endonucleases and DNA ligase.</p> <p>b) Recombinant DNA technology. Application of genetic engineering in medicine.</p> <p>c) Application of r DNA technology and genetic engineering in the production of:</p> <p>i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.</p> <p>d) Brief introduction to PCR</p>	<b>22.22%</b>	<b>10</b>
<b>3</b>	<p><b>UNIT- III</b></p> <p>Types of immunity- humoral immunity, cellular immunity</p> <p>a) Structure of Immunoglobulins</p> <p>b) Structure and Function of MHC</p> <p>c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.</p> <p>d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.</p> <p>e) Storage conditions and stability of official vaccines</p> <p>f) Hybridoma technology- Production, Purification and Applications</p> <p>g) Blood products and Plasma Substitutes.</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT- IV</b></p> <p>a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.</p> <p>b) Genetic organization of Eukaryotes and Prokaryotes</p> <p>c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.</p> <p>d) Introduction to Microbial biotransformation and applications.</p> <p>e) Mutation: Types of mutation/mutants.</p>	<b>17.77%</b>	<b>8</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p>a) Fermentation methods and general requirements, study of media, equipment, sterilization methods, aeration process, stirring.</p> <p>b) Large scale production fermenter design and its various controls.</p> <p>c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,</p> <p>d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.</p>	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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, Degrand, 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 Publishing Company, Pennsylvania 1989.

- a. **Course Name:** Pharmaceutical Quality Assurance
- b. **Course Code:** BP606T
- c. **Prerequisite:** Students should have the basic knowledge of analysis and chemistry.
- d. **Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the cGMP aspects in a pharmaceutical industry
<b>CLOBJ 2</b>	Appreciate the importance of documentation
<b>CLOBJ 3</b>	Understand the scope of quality certifications applicable to pharmaceutical industries
<b>CLOBJ 4</b>	Understand the responsibilities of QA & QC departments

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Illustrate the Quality Certifications as applicable to pharmaceutical industries
<b>CLO 2</b>	Recall the organizational and personal responsibilities, details of pharmaceutical industry premises, Equipment and raw materials in pharma industries.
<b>CLO 3</b>	Learn the Good Laboratory Practices and Quality Control aspects in pharmaceutical industry
<b>CLO 4</b>	Acquire and explain the knowledge of Importance of complaints and documentation in Pharmaceutical Industry.
<b>CLO 5</b>	Gain the knowledge of Calibration and Validation in Pharmaceutical Quality Management

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
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1	<b>UNIT – I</b> <b>Quality Assurance and Quality Management concepts:</b> Definition and concept of Quality control, Quality assurance and GMP <b>Total Quality Management (TQM):</b> Definition, elements, philosophies <b>ICH Guidelines:</b> purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines <b>Quality by design (QbD):</b> Definition, overview, elements of QbD program, tools <b>ISO 9000 &amp; ISO14000:</b> Overview, Benefits, Elements, steps for registration <b>NABL accreditation :</b> Principles and procedures	22.22%	10
2	<b>UNIT – II</b> <b>Organization and personnel:</b> Personnel responsibilities, training, hygiene and personal records. <b>Premises:</b> Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. <b>Equipments and raw materials:</b> Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	22.22%	10
3	<b>UNIT- III</b> <b>Quality Control:</b> Quality control test for containers, rubber closures and secondary packing materials. <b>Good Laboratory Practices:</b> 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	22.22%	10
4	<b>UNIT- IV</b> <b>Complaints:</b> Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. <b>Document maintenance in pharmaceutical industry:</b> Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	17.77%	8
5	<b>UNIT – V</b> <b>Calibration and Validation:</b> 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. <b>Warehousing:</b> Good warehousing practice, materials management	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 – Sadhan 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 Dekker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

**Semester VII**

- a. Course Name:** Instrumental Methods of Analysis
- b. Course Code:** BP701T
- c. Prerequisite:** Students should have the basic knowledge of instruments and analysis.
- d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
<b>CLOBJ 2</b>	Understand the chromatographic separation and analysis of drugs.
<b>CLOBJ 3</b>	Perform quantitative & qualitative analysis of drugs using various analytical instruments.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Summarize interaction of Electromagnetic radiation with matter, Spectroscopic technique including UV-Visible and Fluorimetry theory, Instrumentation and Application
<b>CLO 2</b>	Explain spectroscopic technique like IR, Flame photometry, atomic absorption and Nephelometry.
<b>CLO 3</b>	Understand chromatographic separation and analysis including TLC, Paper, Column chromatography and HPLC
<b>CLO 4</b>	Acquire knowledge of advanced chromatographic methods like Gas, ion exchange, affinity and gel chromatography theory, instrumentation and applications; Electrophoresis – theory and application
<b>CLO 5</b>	Carry out qualitative and quantitative analysis of drug using instrumental analytical techniques

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
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1	<p><b>UNIT-I</b></p> <p><b>UV Visible spectroscopy</b> 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</p> <p><b>Fluorimetry</b> Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications</p>	22.22%	10
2	<p><b>UNIT-II</b></p> <p><b>IR spectroscopy</b> Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications <b>Flame Photometry</b>-Principle, interferences, instrumentation and applications <b>Atomic absorption spectroscopy</b> Principle, interferences, instrumentation and applications <b>Nepheloturbidometry</b>- Principle, instrumentation and applications</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p><b>Introduction to chromatography</b></p> <p>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</p>	22.22%	10
4	<b>UNIT-IV</b>	17.77%	8

	<b>Gas chromatography</b> Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications <b>High performance liquid chromatography (HPLC)</b> -Introduction, theory, instrumentation, advantages and applications		
5	<b>UNIT-V</b> <b>Ion exchange chromatography-</b> Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications <b>Gel chromatography</b> -Introduction, theory, instrumentation and applications <b>Affinity chromatography</b> -Introduction, theory, instrumentation and applications	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

**j. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
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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

a. **Course Name:** Industrial Pharmacy II

b. **Course Code:** BP702T

c. **Prerequisite:** Students should have the basic knowledge of pharmaceuticals.

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

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the process of pilot plant and scale up of pharmaceutical dosage forms
<b>CLOBJ 2</b>	Understand the process of technology transfer from lab scale to commercial batch
<b>CLOBJ 3</b>	Know different Laws and Acts that regulate pharmaceutical industry
<b>CLOBJ 4</b>	Understand the approval process and regulatory requirements for drug products

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Learn the pilot plant scale up techniques for solids, semisolids, injectables dosage forms.
<b>CLO 2</b>	Understand the guidelines and techniques of technology transfer in Pharmaceutical Industry
<b>CLO 3</b>	Familiarize with the concepts of regulatory affair and comprehend the regulatory requirements and guidelines for drug development and drug approval process
<b>CLO 4</b>	Gain knowledge of the the concept of quality management systems, total quality management, QBD.
<b>CLO 5</b>	Understand the approval process and regulatory requirements for drug products

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p><b>Pilot plant scale up techniques:</b> 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 technolog</p> <p><b>Pilot plant scale up techniques:</b> 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</p>	22.22%	10
2	<p><b>UNIT-II</b></p> <p><b>Technology development and transfer:</b> WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R &amp; 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</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p><b>Regulatory affairs:</b> Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals</p>	22.22%	10

	<b>Regulatory requirements for drug approval:</b> 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		
<b>4</b>	<b>UNIT-IV</b> <b>Quality management systems:</b> 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	<b>17.77%</b>	<b>8</b>
<b>5</b>	<b>UNIT-V</b> 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.	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7<sup>th</sup> April available at [http://en.wikipedia.org/wiki/Regulatory\\_Affairs](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. Regulatory Affairs brought by learning plus, inc. available at <http://www.cgmp.com/ra.htm>.

**a. Course Name:** Pharmacy Practice

**b. Course Code:** BP703T

**c. Prerequisite:** Students should have the basic knowledge of anatomy physiology and pharmacology.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know various drug distribution methods in a hospital
<b>CLOBJ 2</b>	Appreciate the pharmacy stores management and inventory control
<b>CLOBJ 3</b>	Monitor drug therapy of patient through medication chart review and clinical review
<b>CLOBJ 4</b>	Obtain medication history interview and counsel the patients
<b>CLOBJ 5</b>	Identify drug related problems

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the detailed aspects and elements of hospital organization, hospital Pharmacy, Adverse drug reaction and community pharmacy
<b>CLO 2</b>	Learn the concept of drug distribution system in hospital, Hospital formulary, therapeutic drug monitoring, medication adherence, patient medication history and community pharmacy management
<b>CLO 3</b>	Understand the organization and functions of pharmacy and therapeutics committee, drug information services, patient counselling, education and training
<b>CLO 4</b>	Recall the concepts of budget preparation and implementation in clinical Pharmacy
<b>CLO 5</b>	Remember the aspects of drug store management and inventory control

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p>a) <b>Hospital and it's organization</b> 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.</p> <p>b) <b>Hospital pharmacy and its organization</b> Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.</p> <p>c) <b>Adverse drug reaction</b> 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.</p> <p>d) <b>Community Pharmacy</b> Organization and structure of retail and wholesale drug store, types and design, Legal requirements for</p>	22.22%	10

	establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.		
2	<p><b>UNIT-II</b></p> <p><b>a) Drug distribution system in a hospital</b> 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.</p> <p><b>b) Hospital formulary</b> Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.</p> <p><b>c)Therapeutic drug monitoring</b> Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.</p> <p><b>d)Medication adherence</b> Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.</p> <p><b>e) Patient medication history interview</b> Need for the patient medication history interview, medication interview forms.</p> <p><b>f) Community pharmacy management</b> Financial, materials, staff, and infrastructure requirements.</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p><b>a) Pharmacy and therapeutic committee</b> 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.</p> <p><b>b) Drug information services</b> Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.</p> <p><b>c)Patient counselling</b> Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist</p> <p><b>d)Education and training program in the hospital</b> 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.</p> <p><b>e) Prescribed medication order and communication skills</b></p>	22.22%	10

	Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients		
4	<b>UNIT-IV</b> <b>a) preparation and implementation:</b> Budget preparation and implementation <b>b) Clinical Pharmacy:</b> 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. <b>c) Over the counter (OTC) sales:</b> Introduction and sale of over the counter, and Rational use of common over the counter medications.	17.77%	8
5	<b>UNIT-V</b> <b>Drug store management and inventory control:</b> 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:</b> Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. <b>Interpretation of Clinical Laboratory Tests:</b> Blood chemistry, hematology, and urinalysis	15.55%	7
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

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



4	-	-	4	15	10	-	75	-	100
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**j. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Controlled drug delivery systems:</b> 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.</p> <p><b>Polymers:</b> Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.</p>	22.22%	10
2	<p><b>UNIT-II</b>  <b>Microencapsulation:</b> Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications.</p> <p><b>Mucosal Drug Delivery system:</b> Introduction, Principles of bioadhesion/ mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems</p> <p><b>Implantable Drug Delivery Systems:</b> Introduction, advantages and disadvantages, concept of implants and osmotic pump.</p>	22.22%	10
3	<p><b>UNIT-III</b>  <b>Transdermal Drug Delivery Systems:</b> Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.</p> <p><b>Gastroretentive drug delivery systems:</b> Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems, inflatable and gastroadhesive systems and their applications.</p> <p><b>Nasopulmonary drug delivery system:</b> Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.</p>	22.22%	10
4	<b>UNIT-IV</b>	17.77%	8

	Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.		
<b>5</b>	<b>UNIT-V</b> Ocular Drug Delivery Systems: Introduction, intraocular 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.	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100 %</b>	<b>45</b>

#### **h. Text Book and Reference Book:**

1. Y W. Chien, Novel Drug Delivery Systems, 2<sup>nd</sup> 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.

### Semester 8

- a. **Course Name:** Biostatistics and Research Methodology
- b. **Course Code:** BP801T
- c. **Prerequisite:** Students should have the basic knowledge of statics and pharmacology.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
<b>CLOBJ 2</b>	Know the various statistical techniques to solve statistical problems
<b>CLOBJ 3</b>	Appreciate statistical techniques in solving the problems.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Recall the concept of health with health education, social education, sociology, and hygiene.
<b>CLO 2</b>	Considerate the concept of preventive medicine by exploring the principles of prevention and control of diseases.
<b>CLO 3</b>	Describe various national health program for its objectives, functioning and outcomes.

<b>CLO 4</b>	Explain the various targeted national interventional program for its objectives, functioning and outcomes.
<b>CLO 5</b>	Understand the role of community services in rural, urban and school health mission.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Introduction:</b> Statistics, Biostatistics, Frequency distribution <b>Measures of central tendency:</b> Mean, Median, Mode- Pharmaceutical examples <b>Measures of dispersion:</b> Dispersion, Range, standard deviation, Pharmaceutical problems <b>Correlation:</b> Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	22.22%	10
2	<b>UNIT-II</b> <b>Regression:</b> 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 <b>Probability:</b> 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 <b>Parametric test:</b> t-test (Sample, Pooled or Unpaired)	22.22%	10
3	<b>UNIT-III</b>	22.22%	10

	<p><b>Non-Parametric tests:</b> Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test</p> <p><b>Introduction to Research:</b> Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism</p> <p><b>Graphs:</b> Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph</p> <p><b>Designing the methodology:</b> 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.</p>		
4	<p><b>UNIT-IV</b></p> <p>Blocking and confounding system for Two-level factorials</p> <p><b>Regression modeling:</b> Hypothesis testing in Simple and Multiple regression models</p> <p><b>Introduction to Practical components of Industrial and Clinical Trials Problems:</b></p> <p>Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS,</p>	17.77%	08
5	<p><b>UNIT-V</b></p> <p><b>Design and Analysis of experiments:</b></p> <p><b>Factorial Design:</b> Definition, 22, 23design. Advantage of factorial design</p> <p><b>Response Surface methodology:</b> Central composite design, Historical design, Optimization Techniques</p>	15.55%	07
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. "Signals and Systems" by Alan V. Oppenheim and Alan S. Willsky.
2. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton,
3. publisher Marcel Dekker Inc. NewYork.
4. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
5. Design and Analysis of Experiments –PHI Learning Private Limited, R.
6. Pannerselvam,
7. Design and Analysis of Experiments – Wiley Students Edition,
8. Douglas and C. Montgomery

- a. **Course Name:** Social and Preventive Pharmacy
- b. **Course Code:** BP802T
- c. **Prerequisite:** Students should have the basic knowledge of health programmes health issues.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.\
<b>CLOBJ 2</b>	Have a critical way of thinking based on current healthcare development.
<b>CLOBJ 3</b>	Evaluate alternative ways of solving problems related to health and pharmaceutical issues

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the concept of health with health education, social education, sociology and hygiene.
<b>CLO 2</b>	Remember the concept of preventive medicine by exploring the principles of prevention and control of diseases.
<b>CLO 3</b>	Learn about various national health program for its objectives, functioning and outcomes.
<b>CLO 4</b>	Understand various targeted national interventional program for its objectives, functioning and outcomes.
<b>CLO5</b>	Remember the role of community services in rural, urban and school health mission.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p><b>Concept of health and disease:</b> 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.</p> <p><b>Social and health education:</b> Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.</p> <p><b>Sociology and health:</b> Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health</p> <p><b>Hygiene and health:</b> personal hygiene and health care; avoidable habits</p>	22.22%	10

<b>2</b>	<b>UNIT- II</b> <b>Preventive medicine:</b> 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	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT -III</b> <b>National health programs, its objectives, functioning and outcome of the following:</b> 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.	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT- IV</b> 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	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT -V</b> 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.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 RoyRabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications

5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

- a. **Course Name:** Pharma Marketing Management
- b. **Course Code:** BP803ET
- c. **Prerequisite:** Students should have the basic knowledge of pharmacology, chemistry and marketing
- d. 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the concepts marketing in pharmaceutical market
<b>CLO 2</b>	Gain the knowledge of the product to be marketed and learn the Product management in pharmaceutical industry
<b>CLO 3</b>	Study the techniques to do the promotion
<b>CLO 4</b>	Learn the details of pharmaceutical marketing channels and know the duties of Professional sales representative (PSR)
<b>CLO 5</b>	Know the pricing methods for pharmaceutical products

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<p><b>Unit-I Marketing:</b> Definition, general concepts and scope of marketing; Distinction between marketing &amp; selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.</p> <p><b>Pharmaceutical market:</b> Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation &amp; targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.</p>	22.22%	10
2	<p><b>Unit -II Product decision:</b> Classification, product line and product mix decisions, product life</p>	22.22%	10

	cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.		
<b>3</b>	<b>Unit -III Promotion:</b> 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	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>Unit-IV Pharmaceutical marketing channels:</b> Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. <b>Professional sales representative (PSR):</b> Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>Unit-V Pricing:</b> 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). <b>Emerging concepts in marketing:</b> Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

i. **Text Book and Reference Book:**

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 Management: Global Perspective, Indian Context, Macmillan 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.

a. **Course Name:** Pharmaceutical Regulatory Science

b. **Course Code:** BP804ET

c. **Prerequisite:** Students should have the basic knowledge of drugs and its legislation.

d. 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know about the process of drug discovery and development
<b>CLOBJ 2</b>	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLOBJ 3</b>	Know the regulatory approval process and their registration in Indian and international markets

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the process of drug discovery and development
<b>CLO 2</b>	Explain the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLO 3</b>	Identify the process of Registration of Indian drug product in overseas market
<b>CLO 4</b>	Explain the process to conduct Clinical trials
<b>CLO 5</b>	Recognize the key Regulatory Concepts.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

<b>Sr. No</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<b>UNIT-I</b> <b>New Drug Discovery and development</b> 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.	<b>22.22%</b>	<b>10</b>
<b>2</b>	<b>UNIT-II</b> <b>Regulatory Approval Process</b> 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. <b>Regulatory authorities and agencies</b> Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT-III</b> <b>Registration of Indian drug product in overseas market</b> 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.	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT-IV</b> <b>Clinical trials</b> 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	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V</b> <b>Regulatory Concepts</b> Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

i. **Text Book and Reference Book:**

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
4. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
5. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene

a. **Course Name:** Pharmacovigilance

b. **Course Code:** BP805ET

c. **Prerequisite:** Students should have the basic knowledge of pharmacology and computer

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Why drug safety monitoring is important?
<b>CLOBJ 2</b>	History and development of pharmacovigilance
<b>CLOBJ 3</b>	National and international scenario of pharmacovigilance
<b>CLOBJ 4</b>	Dictionaries, coding and terminologies used in pharmacovigilance
<b>CLOBJ 5</b>	Detection of new adverse drug reactions and their assessment

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basics of pharmacovigilance and classify adverse drug reactions and their assessment
<b>CLO 2</b>	Remember the International standards for classification of diseases and drugs. List the Dictionaries, coding in pharmacovigilance and also learn to Establish pharmacovigilance programme and know the resources available
<b>CLO 3</b>	Explain about the Vaccine safety surveillance, Pharmacovigilance methods and Communication system in pharmacovigilance
<b>CLO 4</b>	Understand the Methods to generate safety data and know about the ICH guidelines pharmacovigilance
<b>CLO 5</b>	Demonstrate the Pharmacogenomics of ADR Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation. Study the CIOMS and CDSCO requirements for ADR reporting

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p><b>Introduction to Pharmacovigilance</b> History and development of Pharmacovigilance Importance of safety monitoring of Medicine WHO international drug monitoring programme Pharmacovigilance Program of India(PvPI)</p> <p><b>Introduction to adverse drug reactions</b> 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</p> <p><b>Basic terminologies used in pharmacovigilance</b> Terminologies of adverse medication related events. Regulatory terminologies</p>	22.22%	10
2	<p><b>UNIT -II</b></p> <p><b>Drug and disease classification</b> Anatomical, therapeutic and chemical classification of drugs. International classification of diseases Daily defined doses. International Non proprietary Names for drugs</p> <p><b>Drug dictionaries and coding in pharmacovigilance</b> WHO adverse reaction terminologies. MedDRA and Standardised MedDRA queries. WHO drugs dictionary. Eudravigilance medicinal product dictionary</p> <p><b>Information resources in pharmacovigilance</b> Basic drug information resources. Specialised resources for ADRs</p> <p><b>Establishing pharmacovigilance programme</b> Establishing in a hospital. Establishment &amp; operation of drug safety department in industry. Contract Research Organisations (CROs) Establishing a national programme</p>	22.22%	10
3	<p><b>UNIT -III</b></p> <p><b>Vaccine safety surveillance</b></p>	22.22%	10

	<p>Vaccine Pharmacovigilance. Vaccination failure Adverse events following immunization</p> <p><b>Pharmacovigilance methods</b>  Passive surveillance – Spontaneous reports and case series  Stimulated reporting. Active surveillance – Sentinel sites, drug event monitoring and registries. Comparative observational studies – Cross sectional study, case control study and cohort study  Targeted clinical investigations</p> <p><b>Communication in pharmacovigilance</b>  Effective communication in Pharmacovigilance. Communication in Drug Safety Crisis management. Communicating with Regulatory Agencies, Business Partners, Healthcare facilities &amp; Media</p>		
<b>4</b>	<p><b>UNIT -IV</b></p> <p><b>Safety data generation</b>  Pre clinical phase Clinical phase Post approval phase (PMS)</p> <p><b>ICH Guidelines for Pharmacovigilance</b>  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</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>UNIT -V</b></p> <p><b>Pharmacogenomics of adverse drug reactions</b>  Genetics related ADR with example focusing PK parameters.</p> <p><b>Drug safety evaluation in special population</b>  Paediatrics. Pregnancy and lactation. Geriatrics</p> <p><b>CIOMS</b>  CIOMS Working Groups. CIOMS Form</p> <p><b>CDSCO (India) and Pharmacovigilance</b>  D&amp;C Act and Schedule Y. Differences in Indian and global pharmacovigilance requirements</p>	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Quality Control and Standardization of Herbals
- b. **Course Code:** BP806ET
- c. **Prerequisite:** Students should have the basic knowledge of analysis of crud drugs and its regulatory requirement
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Learn the WHO guidelines for quality control of herbal drugs
<b>CLO 2</b>	Check out the Quality assurance in herbal drug industry
<b>CLO 3</b>	Consider the EU and ICH guidelines for quality control of herbal drugs
<b>CLO 4</b>	Know about the Stability testing of herbal medicines
<b>CLO 5</b>	Gain the knowledge about the Regulatory requirements for herbal medicines

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> 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	22.22%	10
2	<b>UNIT - II</b> <b>Quality assurance in herbal drug industry</b> 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.	22.22%	10
3	<b>UNI- III</b> EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.	22.22%	10
4	<b>UNIT -IV</b> 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.	17.77%	08
5	<b>UNIT- V</b> 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	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

- 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

- a. **Course Name:** Computer Aided Drug Design
- b. **Course Code:** BP807ET
- c. **Prerequisite:** Students should have the basic knowledge of orhanic, medicinal chemistry and computer application.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Design and discovery of lead molecules
<b>CLOBJ 2</b>	The role of drug design in drug discovery process
<b>CLOBJ 3</b>	The concept of QSAR and docking
<b>CLOBJ 4</b>	Various strategies to develop new drug like molecules.

<b>CLOBJ 5</b>	The design of new drug molecules using molecular modeling software
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand stages of drug discovery and development
<b>CLO 2</b>	Understand the concept of QSAR
<b>CLO 3</b>	Learn the Molecular Modelling and virtual screening techniques
<b>CLO 4</b>	Introduction to bioinformatics & Methods in drug design
<b>CLO 5</b>	Learn to Design of new drug molecules using molecular modelling software

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT -I</b> <b>Introduction to Drug Discovery and Development</b> Stages of drug discovery and development <b>Lead discovery and Analog Based Drug Design</b> 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. <b>Analog Based Drug Design:</b> Bioisosterism, Classification, Bioisosteric replacement. Any three case studies	22.22%	10
2	<b>UNIT -II</b> <b>Quantitative Structure Activity Relationship (QSAR)</b>	22.22%	10

	SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.		
3	<b>UNIT -III</b> <b>Molecular Modeling and virtual screening techniques</b> <b>Virtual Screening techniques:</b> Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, <b>Molecular docking:</b> Rigid docking, flexible docking, manual docking, Docking based screening. <i>De novo</i> drug design.	22.22%	10
4	<b>UNIT- IV</b> <b>Informatics &amp; Methods in drug design</b> Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	17.77%	08
5	<b>UNIT -V</b> <b>Molecular Modeling:</b> Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.	15.55%	07
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park 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 Ikovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" JohnWiley& Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
  - a. **Course Name:** Cell and Molecular Biology
  - b. **Course Code:** BP808ET
  - c. **Prerequisite:** Students should have the basic knowledge of anatomy and biology.
  - d. **Rationale:** 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 organisms such as humans, plants, and sponges.
  - e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Summarize cell and molecular biology history.
<b>CLOBJ 2</b>	Summarize cellular functioning and composition.
<b>CLOBJ 3</b>	Describe the chemical foundations of cell biology.
<b>CLOBJ 4</b>	Summarize the DNA properties of cell biology.
<b>CLOBJ 5</b>	Describe protein structure and function.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Summarize the basics of cell and molecular biology, Prokaryotic Eukaryotic, their properties Reproduction and Chemical Foundations
<b>CLO 2</b>	Learn the DNA and RNA of cell
<b>CLO 3</b>	Know about the details of protein and its synthesis
<b>CLO 4</b>	Understand the basic molecular genetic mechanisms.
<b>CLO 5</b>	Study the cell signals

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>	<b>15</b>	<b>10</b>	<b>-</b>	<b>75</b>	<b>-</b>	<b>100</b>

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
<b>1</b>	<b>UNIT- I</b> 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.	<b>22.22%</b>	<b>10</b>

	d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)		
<b>2</b>	<b>UNIT- II</b> a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT- III</b> a) Proteins: Defined <b>and</b> Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT- IV</b> a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT- V</b> a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
2. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
3. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
4. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
5. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
6. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
7. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
8. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.

- a. **Course Name:** Cosmetic Science
- b. **Course Code:** BP809ET
- c. **Prerequisite:** Students should have the basic knowledge of pharmaceuticals.
- d. **Rationale:** This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Key ingredients used in cosmetics and cosmeceuticals.
<b>CLOBJ 2</b>	Key building blocks for various formulations
<b>CLOBJ 3</b>	Current technologies in the market
<b>CLOBJ 4</b>	Various key ingredients and basic science to develop cosmetics and cosmeceuticals
<b>CLOBJ 5</b>	Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Know and explain about cosmetics, and related sciences, cosmeceuticals (cosmetics with skin, hair and oral care benefits) and personal care and hygiene products.
<b>CLO 2</b>	Principles of formulation and building blocks of skin and hair care products
<b>CLO 3</b>	Study the Role of herbs in cosmetics and know about the Analytical cosmetics
<b>CLO 4</b>	Study the Principles of Cosmetic Evaluation
<b>CLO 5</b>	Describe about basic cosmetic problems associated with skin, hair and oral care etc.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>            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  <b>Cosmetic excipients:</b> Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application  <b>Skin:</b> Basic structure and function of skin.  <b>Hair:</b> Basic structure of hair. Hair growth cycle.  <b>Oral Cavity:</b> Common problem associated with teeth and gums.</p>	22.22%	10
2	<p><b>UNIT-II</b>  <b>Principles of formulation and building blocks of skin care products:</b>            Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.  <b>Antiperspirants &amp; deodorants-</b> Actives &amp; mechanism of action.  <b>Principles of formulation and building blocks of Hair care products:</b>            Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phenylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.</p>	22.22%	10
3	<p><b>UNIT-III</b>            Sun protection, Classification of Sunscreens and SPF.  <b>Role of herbs in cosmetics:</b>            Skin Care: Aloe and turmeric            Hair care: Henna and amla.            Oral care: Neem and clove  <b>Analytical cosmetics:</b> BIS specification and analytical methods for shampoo, skin cream and toothpaste.</p>	22.22%	10
4	<p><b>UNIT- IV</b>            Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.</p>	17.77%	08
5	<p><b>UNIT-V</b>            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 cause Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.</p>	15.55%	07

	Antiperspirants and Deodorants- Actives and mechanism of action		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Experimental Pharmacology  
 b. **Course Code:** BP810ET  
 c. **Prerequisite:** Students should have the basic knowledge of pharmacology.  
 d. **Rationale:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Appreciate the applications of various commonly used laboratory animals.
<b>CLOBJ 2</b>	Appreciate and demonstrate the various screening methods used in preclinical research
<b>CLOBJ 3</b>	Appreciate and demonstrate the importance of biostatistics and research methodology
<b>CLOBJ 4</b>	Design and execute a research hypothesis independently

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Appreciate the applications of various commonly used laboratory animals
<b>CLO 2</b>	Study the preclinical studies and screening models for drugs acting on ANS
<b>CLO 3</b>	Demonstrate the various screening methods used in preclinical research for drugs acting on CNS
<b>CLO 4</b>	Demonstrate the various screening methods used in preclinical research for drugs acting on CVS
<b>CLO 5</b>	Recognize the importance of biostatistics and research methodology

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

- h. **Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT- 1</b> <b>Laboratory Animals:</b> 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.	22.22%	10
2	<b>UNIT- II</b> <b>Preclinical screening models</b> 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. <b>Study of screening animal models for</b> Diuretics, nootropics, anti-Parkinson's, antiasthmatics, <b>Preclinical screening models:</b> for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	22.22%	10
3	<b>UNIT- III</b> <b>Preclinical screening models:</b> for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics	22.22%	10
4	<b>UNIT- IV</b> <b>Preclinical screening models:</b> for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	17.77%	08
5	<b>UNIT- V</b> <b>Research methodology and Bio-statistics</b> 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	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 Rao and J Richard

- a. **Course Name:** Advanced Instrumentation Techniques
- b. **Course Code:** BP811ET
- c. **Prerequisite:** Students should have the basic knowledge of analysis and instruments.
- d. **Rationale:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the advanced instruments used and its applications in drug analysis
<b>CLOBJ 2</b>	Understand the chromatographic separation and analysis of drugs.
<b>CLOBJ 3</b>	Understand the calibration of various analytical instruments
<b>CLOBJ 4</b>	Know analysis of drugs using various analytical instruments.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Learn the fundamentals of advanced analytical techniques like Nuclear Magnetic Resonance spectroscopy and Mass Spectrometry and the related instruments
<b>CLO 2</b>	Understand the fundamentals of advanced analytical techniques like Thermal Methods of Analysis and Mass Spectrometry
<b>CLO 3</b>	Summarize the calibration and validation of various analytical instruments
<b>CLO 4</b>	Gain knowledge about the importance, principle application of Radio immune assay and Extraction techniques
<b>CLO 5</b>	Study the details of Hyphenated techniques

**g. Teaching & Examination Scheme:**

<b>Teaching Scheme</b>	<b>Evaluation Scheme</b>
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L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-1</b> <b>Nuclear Magnetic Resonance spectroscopy</b> Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications <b>Mass Spectrometry-</b> Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	22.22%	10
2	<b>UNIT- II</b> <b>Thermal Methods of Analysis:</b> Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) <b>X-Ray Diffraction Methods:</b> Origin of X-rays, basic aspects of crystals, Xray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.	22.22%	10
3	<b>UNIT -III</b> <b>Calibration and validation-</b> as per ICH and USFDA guidelines <b>Calibration of following Instruments</b> Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC	22.22%	10
4	<b>UNIT -IV</b> <b>Radio immune assay:</b> Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay <b>Extraction techniques:</b> General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	17.77%	08
5	<b>UNIT -V</b> <b>Hyphenated techniques-</b> LC-MS/MS, GC-MS/MS, HPTLC-MS.	15.55%	07

**i. Text Book and Reference Book:**

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

a. **Course Name:** Dietary Supplements and Nutraceuticals

b. **Course Code:** BP812ET

c. **Prerequisite:** Students should have the basic knowledge of pharmacology and chemistry.

d. **Rationale:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

e. **Course Learning Objective:**

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

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Outline the need of dietary supplements and Nutraceuticals to maintain healthy life.
<b>CLO 2</b>	Find about the Occurrence and characteristic features of Phytochemicals as nutraceuticals
<b>CLO 3</b>	Demonstrate the free radicals and Dietary fibres
<b>CLO 4</b>	Understand the outcome of deficiencies in dietary supplements
<b>CLO 5</b>	Appreciate the regulatory and commercial aspects of dietary supplements including health claims

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> 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	22.22%	10

<b>2</b>	<b>UNIT-II</b> Phytochemicals as nutraceuticals: Occurrence and characteristic features(chemical nature medicinal benefits) of following a) Carotenoids- $\alpha$ and $\beta$ -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.	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT-III</b> 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.	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT-IV</b> 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, $\alpha$ - Lipoic acid, melatonin. Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V</b> 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.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPublication.

2. Advanced Nutritional Therapies by Cooper. K.A., (1996).
3. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
4. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn. Avery Publishing Group, NY (1997).
5. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead Publ.Co.London.
6. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.
7. 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.
8. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
9. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eight edition. Lea and Febiger

a. **Course Name:** Pharmaceutical Product Development

b. **Course Code:** BP813ET

c. **Prerequisite:**

d. **Rationale:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

**e. Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basic concepts of Preformulation, stability, manufacturing and quality control in pharmaceutical product development
<b>CLO 2</b>	Study the excipients used in liquid and semisolid pharmaceutical product development
<b>CLO 3</b>	Study the excipients used in solid, parenteral and novel pharmaceutical product development
<b>CLO 4</b>	Study various optimization techniques in pharmaceutical product development
<b>CLO 5</b>	Study and quality control testing of packaging material.

**g. Teaching & Examination Scheme:**

<b>Teaching Scheme</b>				<b>Evaluation Scheme</b>					
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Internal Evaluation</b>			<b>ESE</b>		<b>Total</b>
				<b>MSE</b>	<b>CE</b>	<b>P</b>	<b>Theory</b>	<b>P</b>	
<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>	<b>15</b>	<b>10</b>	<b>-</b>	<b>75</b>	<b>-</b>	<b>100</b>

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**Course Content:**

<b>Sr. No</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<b>UNIT-I</b> 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	<b>22.22%</b>	<b>10</b>
<b>2</b>	<b>UNIT-II</b> 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	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT-III</b> 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	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT-IV</b> 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.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V</b> Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100 %</b>	<b>45</b>

#### **h. Text Book and Reference Book:**

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 and Leon Lachman; Marcel Dekker, Inc.
4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop Khar, 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 and Joseph 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

And H.A. Libermann.

13 Advanced Review Articles related to the topics.

### **ANNEXURE-III**

#### **Semester 1**

- a. **Course Name:** Human Anatomy and Physiology I
- b. **Course Code:** BP101T
- c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the various experiments related to special senses and nervous system.
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Recall and understand the anatomy and physiology of Human body and know the cellular and tissue level organization
<b>CLO 2</b>	Compare and study the anatomy and physiology of skin, skeletal system and joints.
<b>CLO 3</b>	Explain the role and functioning of blood and lymphatic system
<b>CLO 4</b>	Compare and contrast the anatomy and physiology of organs of the cardio vascular system, special senses and peripheral nervous system.
<b>CLO 5</b>	Demonstrate the ability to perform experiments on living issue and normal human beings and also perform the Hematological tests.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Introduction to human body</b> Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. <b>Cellular level of organization</b>	22.22%	10

	<p>Structure and functions of cell, transport across cell membrane, cell division, cell junctions.</p> <p>General principles of cell communication, intracellular signalling pathway activation by extracellular signal molecule, Forms of intracellular signalling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine</p> <p><b>Tissue level of organization</b></p> <p>Classification of tissues, structure, location, and functions of epithelial, muscular, and nervous and connective tissues.</p>		
2	<p><b>UNIT – II</b></p> <p><b>Integumentary system</b> Structure and functions of skin</p> <p><b>Skeletal system</b> 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</p> <p><b>Joints</b> Structural and functional classification, types of joints movements and its articulation</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Body fluids and blood</b></p> <p>Body fluids, composition, and functions of blood, hemopoiesis, formation of haemoglobin, anaemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo-endothelial system.</p> <p><b>Lymphatic system</b> Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Peripheral nervous system:</b> Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.</p> <p><b>Special senses</b> Structure and functions of eye, ear, nose and tongue and their disorders.</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Cardiovascular system</b> Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.</p>	15.55%	07

	<b>Total</b>	<b>100%</b>	<b>45</b>
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**i. Textbook and Reference Book:**

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.

**j. Reference Books (Latest Editions)**

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Textbook 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. Chatterjee, Academic Publishers Kolkata

a. **Course Name:** Pharmaceutical Analysis I

**b. Course Code: BP102T****c. Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.**d. Rationale:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understanding the principles of volumetric and electro chemical analysis
<b>CLOBJ 2</b>	Carryout various volumetric and electrochemical titrations.
<b>CLOBJ 3</b>	Develop analytical skills

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand analytical techniques, concentration expression methods, and standards differentiation and preparation and standardization of various solutions. To study the overall concept of errors including methods of minimizing errors. Overview of Pharmacopoeia, Impurities and Limit Tests.
<b>CLO 2</b>	Illustrate the principles of Volumetric analysis by performing acid-base titrations, non-aqueous titrations.
<b>CLO 3</b>	Understand of Precipitation Titrations complexometric titrations, Gravimetry and Diazotisation Titration.
<b>CLO 4</b>	Explain Redox titrations and Electrochemical methods.
<b>CLO 5</b>	Develop the analytical skill by performing limit tests and titrations and doing the experiments on preparation, standardization, Assay of certain compounds.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Pharmaceutical analysis-</b> Definition and scope Different techniques of analysis; Methods of expressing concentration; Primary and secondary standards. Preparation and standardization of various molar and normal solutions-	22.22%	10

	<p>Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate</p> <p><b>Errors:</b> Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures</p> <p><b>Pharmacopoeia:</b> Sources of impurities in medicinal agents, limit tests.</p>		
2	<p><b>UNIT – II</b></p> <p><b>Acid base titration:</b> 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</p> <p><b>Non aqueous titration:</b> Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Precipitation titrations:</b> Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.</p> <p><b>Complexometric titration:</b> Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.</p> <p><b>Gravimetry:</b> Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.</p> <p>Basic Principles, methods and application of diazotisation titration.</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Redox titrations</b></p> <p>(a) Concepts of oxidation and reduction</p> <p>(b) Types of redox titrations (Principles and applications)</p> <p>Cerimetry, Iodimetry, Iodometry, Bromometry, Dichrometry, Titration with potassium iodate.</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Electrochemical methods of analysis</b></p> <p><b>Conductometry-</b> Introduction, Conductivity cell, Conductometric titrations, applications.</p> <p><b>Potentiometry –</b> 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.</p> <p><b>Polarography -</b> Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications</p>	15.55%	07

	<b>Total</b>	<b>100%</b>	<b>45</b>
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**i. Text Book and Reference Book:**

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

- a. **Course Name:** Pharmaceutics-I  
 b. **Course Code:** BP103T  
 c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.  
 d. **Rationale:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the history of profession of pharmacy
<b>CLOBJ 2</b>	Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
<b>CLOBJ 3</b>	Understand the professional way of handling the prescription
<b>CLOBJ 4</b>	Preparation of various conventional dosage forms

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Comprehend the history of the pharmacy profession, Introduction to Dosage form prescription handling and explain posology
<b>CLO 2</b>	Compare and contrast different dosage forms like powders, Liquid dosage forms and pharmaceutical calculations
<b>CLO 3</b>	Demonstrate an understanding of monophasic liquid dosage forms Biphasic liquid dosage forms and pharmaceutical Incompatibilities
<b>CLO 4</b>	Illustrate semisolid dosage forms and suppositories including displacement value calculation
<b>CLO 5</b>	Perform the preparation of various conventional dosage forms

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

	-	4	2			15		35	50
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Historical background and development of profession of pharmacy:</b> 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.</p> <p><b>Dosage forms:</b> Introduction to dosage forms, classification and definitions</p> <p><b>Prescription:</b> Definition, Parts of prescription, handling of Prescription and Errors in prescription.</p> <p><b>Posology:</b> Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Pharmaceutical calculations:</b> Weights and measures – Imperial &amp; Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.</p> <p><b>Powders:</b> Definition, classification, advantages and disadvantages, Simple &amp; compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.</p> <p><b>Liquid dosage forms:</b> Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Monophasic liquids:</b> Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.</p> <p><b>Biphasic liquids:</b></p> <p><b>Suspensions:</b> Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and</p>	22.22%	10

	Deflocculated suspension & stability problems and methods to overcome. <b>Emulsions:</b> Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.		
<b>4</b>	<b>UNIT – IV</b> <b>Suppositories:</b> Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. <b>Pharmaceutical incompatibilities:</b> Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> <b>Semisolid dosage forms:</b> 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	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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. Françoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

a. **Course Name:** Pharmaceutical Inorganic Chemistry

b. **Course Code:** BP104T

c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.

d. **Rationale:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
<b>CLOBJ 2</b>	Understand the medicinal and pharmaceutical importance of inorganic compounds

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the sources of impurities in inorganic Drugs and pharmaceuticals and testing of impurities.
<b>CLO 2</b>	Learn about medicinal and pharmaceutical Importance of acids, bases, buffers, electrolytes and dental products.
<b>CLO 3</b>	Understand the medicinal and pharmaceutical uses of gastrointestinal agents and antimicrobials
<b>CLO 4</b>	Study the inorganic miscellaneous compounds and radiopharmaceuticals.
<b>CLO 5</b>	Demonstrate and explain the practicals on limit tests, identification test, test for purity and preparation of pharmaceutical inorganic compounds.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Impurities in pharmaceutical substances:</b> 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</p> <p><b>General methods of preparation,</b> assay for the compounds superscripted with <b>asterisk</b>, properties and medicinal uses of inorganic compounds belonging to the following classes</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Acids, Bases and Buffers:</b> 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.</p> <p><b>Major extra and intracellular electrolytes:</b> 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.</p>	22.22%	10

	<b>Dental products:</b> Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.		
<b>3</b>	<b>UNIT – III</b> <b>Gastrointestinal agents</b> <b>Acidifiers:</b> Ammonium chloride and Dil. HCl <b>Antacid:</b> Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate , Aluminium hydroxide gel, Magnesium hydroxide mixture <b>Cathartics:</b> Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite <b>Antimicrobials:</b> Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide , Chlorinated lime , Iodine and its preparations	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT – IV</b> <b>Miscellaneous compounds</b> <b>Expectorants:</b> Potassium iodide, Ammonium chloride . <b>Emetics:</b> Copper sulphate , Sodium potassium tartarate <b>Haematinics:</b> Ferrous sulphate , Ferrous gluconate <b>Poison and Antidote:</b> Sodium thiosulphate , Activated charcoal, Sodium nitrite <b>Astringents:</b> Zinc Sulphate, Potash Alum	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> <b>Radiopharmaceuticals:</b> Radio activity, Measurement of radioactivity, Properties of $\alpha$ , $\beta$ , $\gamma$ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

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, Textbook 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

- a. **Course Name:** Communication skills
- b. **Course Code:** BP105T
- c. **Prerequisite:** Students should have effective speaking and writing ability and self-awareness.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

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

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basics of Communication skills, the barriers and its perspectives.
<b>CLO 2</b>	Know about the communication style and acquire the knowledge about the elements of communication
<b>CLO 3</b>	Learn the basic Listening and writing Skills
<b>CLO 4</b>	Develop the skills of facing interview, giving presentation and group discussion
<b>CLO 5</b>	Learn the practical aspects of communication skill to develop interview facing ability and leadership qualities.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Communication Skills:</b> Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context</p> <p><b>Barriers to communication:</b> Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers</p> <p><b>Perspectives in Communication:</b> Introduction, Visual Perception, Language, Other factors affecting our</p>	23.33%	07

	perspective - Past Experiences, Prejudices, Feelings, Environment		
<b>2</b>	<b>UNIT – II</b> <b>Elements of Communication:</b> Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication <b>Communication Styles:</b> Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	<b>23.33%</b>	<b>07</b>
<b>3</b>	<b>UNIT – III</b> <b>Basic Listening Skills:</b> Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations <b>Effective Written Communication:</b> Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication <b>Writing Effectively:</b> Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	<b>23.33%</b>	<b>07</b>
<b>4</b>	<b>UNIT – IV</b> <b>Interview Skills:</b> Purpose of an interview, Do's, and Don'ts of an interview <b>Giving Presentations:</b> Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	<b>16.66%</b>	<b>05</b>
<b>5</b>	<b>UNIT – V</b> <b>Group Discussion:</b> Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	<b>13.33%</b>	<b>04</b>
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Textbook and Reference Book:**

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, 5<sup>th</sup> 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, 4<sup>th</sup> Edition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 1999

- a. **Course Name:** Remedial Biology
- b. **Course Code:** BP106RBT

- c. **Prerequisite:** Students who have opted for Mathematics at their Higher secondary examination and have a combination of Biology/Mathematics or both in addition to Physics, and Chemistry.
- d. **Rationale:** To learn and understand the components of living world, structure and functional system of plant and animal kingdom.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the classification and salient features of five kingdoms of life
<b>CLOBJ 2</b>	Understand the basic components of anatomy & physiology of plant
<b>CLOBJ 3</b>	Know understand the basic components of anatomy & physiology animal with special reference to human

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand and classify living world and morphology of flowering plants
<b>CLO 2</b>	Study of body fluids, their circulation and understanding of functioning of respiratory system
<b>CLO 3</b>	Recall of the anatomy and physiology of human excretory system, nervous system, reproductive system and endocrine glands.
<b>CLO 4</b>	Demonstrate the anatomy & physiology of plants
<b>CLO 5</b>	Identification of plant parts and bones and to learn methods of blood group, blood pressure and tidal volume measurement

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Living world:</b> Definition and characters of living organisms, Diversity in the living world, Binomial nomenclature, Five kingdoms of	23.33%	07

	<p>life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus,</p> <p><b>Morphology of Flowering plants</b> Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons &amp; Dicotyledons.</p>		
2	<p><b>UNIT – II</b></p> <p><b>Body fluids and circulation</b> 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</p> <p><b>Digestion and Absorption</b> Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food</p> <p><b>Breathing and respiration</b> Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes</p>	23.33%	07
3	<p><b>UNIT – III</b></p> <p><b>Excretory products and their elimination</b> Modes of excretion; Human excretory system- structure and function; Urine formation; Rennin angiotensin system.</p> <p><b>Neural control and coordination</b> 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</p> <p><b>Chemical coordination and regulation</b> Endocrine glands and their secretions Functions of hormones secreted by endocrine glands</p> <p><b>Human reproduction</b> Parts of female reproductive system; parts of male reproductive system; Spermatogenesis and Oogenesis; Menstrual cycle</p>	23.33%	07
4	<p><b>UNIT – IV</b></p> <p><b>Plants and mineral nutrition:</b> Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation</p> <p><b>Photosynthesis</b> Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.</p>	16.66%	05
5	<p><b>UNIT – V</b></p> <p><b>Plant respiration:</b> Respiration, glycolysis, fermentation (anaerobic).</p> <p><b>Plant growth and development</b> Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators</p>	13.33%	04

	<b>Cell - The unit of life</b> Structure and functions of cell and cell organelles. Cell division <b>Tissues</b> Definition, types of tissues, location and functions.		
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Textbook and Reference Book:**

1. Textbook of Biology by S. B. Gokhale
2. A Textbook of Biology by Dr. Thulajappa and Dr. Seetaram

**Reference Books**

1. A Textbook of Biology by B.V. Sreenivasa Naidu
2. A Textbook of Biology by Naidu and Murthy
3. Botany for Degree students By A.C. Dutta
4. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan
5. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

- a. **Course Name:** Remedial Mathematics
- b. **Course Code:** BP106RMT
- c. **Prerequisite:** Students who have opted for Biology as their main subject at their Higher secondary examination and have a combination of Biology/Mathematics or both in addition to Physics, and Chemistry
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the theory and their application in Pharmacy
<b>CLOBJ 2</b>	Solve the different types of problems by applying theory
<b>CLOBJ 3</b>	Appreciate the important application of mathematics in Pharmacy

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Solve simple problems associated with functions, Limits, continuity, Logarithms' and partial fractions.
<b>CLO 2</b>	Apply the appropriate standard form of matrix and solve simple mathematical problems associated with matrix algebra in solving Pharmacokinetic equations
<b>CLO 3</b>	Know about theory and application of calculus in pharmacy
<b>CLO 4</b>	Explains the principles of analytical geometry and Integration
<b>CLO 5</b>	Understand the role of Differential Equations and Laplace Transform in pharmacy.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Partial fraction</b> Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics</p> <p><b>Logarithms</b> Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.</p> <p><b>Function:</b> Real Valued function, Classification of real valued functions,</p> <p><b>Limits and continuity:</b> Introduction, Limit of a function, Definition of limit of a function.</p>	20 %	06
2	<p><b>UNIT – II</b></p> <p><b>Matrices and Determinant:</b> Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer’s rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving, Pharmacokinetic equations</p>	20 %	06
3	<p><b>UNIT – III</b></p> <p><b>Calculus</b> <b>Differentiation:</b> 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) – <b>Without Proof</b>, Derivative of <math>x^n</math> w.r.t <math>x</math>, where <math>n</math> is any rational number, Derivative of <math>e^x</math>, Derivative of <math>\log_e x</math>, Derivative of <math>ax</math>; Derivative of trigonometric functions from first principles (<b>without Proof</b>), Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application</p>	20 %	06
4	<p><b>UNIT – IV</b></p> <p><b>Analytical Geometry</b> <b>Introduction:</b> Signs of the Coordinates, Distance formula, <b>Straight Line:</b> Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines,</p>	20 %	06

	Slope of a line joining two points, Slope – intercept form of a straight line <b>Integration:</b> Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.		
<b>5</b>	<b>UNIT – V</b>  <b>Differential Equations:</b> Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, <b>Application in solving Pharmacokinetic equations</b> <b>Laplace Transform:</b> Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, <b>Application in solving Chemical kinetics and Pharmacokinetics equations</b>	<b>20 %</b>	<b>06</b>
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Text Book and Reference Book:**

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 2

- a. **Course Name:** Human Anatomy and Physiology-II
- b. **Course Code:** BP201T
- c. **Prerequisite:** Students who have background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the hematological tests like blood cell counts, hemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the anatomy and physiology of nervous system and describe the digestive system
<b>CLO 2</b>	Describe the anatomy and physiology of respiratory system and energetics
<b>CLO 3</b>	Understand the anatomy and physiology of endocrine system and urinary system
<b>CLO 4</b>	Understand the anatomy and physiology of reproductive system and study of genetics
<b>CLO 5</b>	Demonstrate anatomy and physiology of various organs with the help of models and charts as well as practical understanding of their functions

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Nervous system</b> Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.</p> <p><b>Central nervous system:</b> 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)</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Digestive system</b> 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.</p> <p><b>Energetics</b> Formation and role of ATP, Creatinine Phosphate and BMR.</p>	13.33%	6
3	<p><b>UNIT – III</b></p> <p><b>Respiratory system</b> 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.</p> <p><b>Urinary system</b></p>	22.22%	10

	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.		
<b>4</b>	<b>UNIT – IV</b> <b>Endocrine system</b> 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.	<b>22.22%</b>	<b>10</b>
<b>5</b>	<b>UNIT – V</b> <b>Reproductive system</b> 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 <b>Introduction to genetics</b> Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	<b>20 %</b>	<b>09</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

- a. **Course Name:** Pharmaceutical Organic Chemistry-I
- b. **Course Code:** BP202T
- c. **Prerequisite:** Students should have background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Write the structure, name and the type of isomerism of the organic compound
<b>CLOBJ 2</b>	Write the reaction, name the reaction and orientation of reactions
<b>CLOBJ 3</b>	Account for reactivity/stability of compounds,
<b>CLOBJ 4</b>	Identify /confirm the identification of organic compound

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain and classify organic compounds, nomenclature, and structural isomerism of organic compounds, carboxylic acids.
<b>CLO 2</b>	Study of Alkanes, Alkenes and Conjugated Dienes
<b>CLO 3</b>	Explain the Alkyl halides and alcohols, Explain and classify organic compounds
<b>CLO 4</b>	Study of carbonyl compounds, and Aliphatic Amines with reactions.
<b>CLO 5</b>	Identify unknown organic compound Understand qualitative analysis of unknown organic compounds, preparation of solid derivatives, and construction of molecular models

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Classification, nomenclature and isomerism</b>            Classification of Organic Compounds            Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerism's in organic compounds</p>	15.55%	7
2	<p><b>UNIT – II</b></p> <p><b>Alkanes , Alkenes and Conjugated dienes</b>            SP<sup>3</sup> hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP<sup>2</sup> hybridization in alkenes. E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p>SN<sup>1</sup> and SN<sup>2</sup> reactions - kinetics, order of reactivity of alkyl halides, stereochemistry, and rearrangement of carbocations. SN<sup>1</sup> versus SN<sup>2</sup> reactions, Factors affecting SN<sup>1</sup> and SN<sup>2</sup> reactions. Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.</p>	22.22%	10

	<b>Alcohols</b> - Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol		
<b>4</b>	<b>UNIT – IV</b>  <b>Carbonyl compounds (Aldehydes and ketones)</b> Nucleophilic-addition, electrometric-effect, aldol-condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanillin, Cinnamaldehyde.	<b>22.22%</b>	<b>10</b>
<b>5</b>	<b>UNIT – V</b>  <b>Carboxylic acids</b> 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 <b>Aliphatic amines</b> - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	<b>17.77 %</b>	<b>08</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 textbook 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.

- a. **Course Name:** Biochemistry
- b. **Course Code:** BP203T
- c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes
<b>CLOBJ 2</b>	Understand the metabolism of nutrient molecules in physiological and pathological conditions.
<b>CLOBJ 3</b>	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study of the biomolecules, bioenergetics and detailed study on enzymes
<b>CLO 2</b>	Understand the biological oxidation and study the metabolism of carbohydrates in physiological and pathological conditions
<b>CLO 3</b>	Explain the metabolism of nutrient molecules like lipids and amino acids in physiological and pathological conditions.
<b>CLO 4</b>	Study of Nucleic acid metabolism and genetic information transfer, the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins
<b>CLO 5</b>	Perform the qualitative and quantitative analysis of biomolecules, factors affecting on enzymes activity, preparation of buffer solution.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Biomolecules</b> Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. <b>Bioenergetics</b> 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	15.55%	7
2	<b>UNIT – II</b> <b>Carbohydrate metabolism</b> Glycolysis – Pathway, energetics and significance Citric acid cycle- Pathway, energetics and significance	22.22%	10

	<p>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</p> <p><b>Biological oxidation</b> Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation &amp; its mechanism and substrate Phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers.</p>		
3	<p><b>UNIT – III</b></p> <p><b>Lipid metabolism</b> 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.</p> <p><b>Amino acid metabolism</b> General reactions of amino acid metabolism: Transamination, deamination &amp; decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia). Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline. Catabolism of heme; hyperbilirubinemia and jaundice</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Nucleic acid metabolism and genetic information transfer</b> 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.</p>	22.22%	10
5	<p><b>UNIT – V</b></p> <p><b>Enzymes</b> 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</p>	15.55 %	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**a. Course Name:** Pathophysiology

**b. Course Code:** BP204T

**c. Prerequisite:** Students should have a basic understanding of Human anatomy and Physiology, Biology, and Chemistry.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	1. Describe the etiology and pathogenesis of the selected disease states;
<b>CLOBJ 2</b>	2. Name the signs and symptoms of the diseases; and
<b>CLOBJ 3</b>	3. Mention the complications of the diseases.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Describe the basic pathophysiological mechanisms like cell injury, adaptation, Inflammation and repair.
<b>CLO 2</b>	Explain the etiology, pathophysiology, clinical manifestations and complications of cardiovascular, Respiratory and renal diseases.
<b>CLO 3</b>	Describe the etiology, pathophysiology, clinical manifestations and complications of hematological, endocrinal, nervous and Gastrointestinal system related diseases.
<b>CLO 4</b>	Discuss the etiology pathophysiology, clinical Manifestations and complications of bone and joints and principles of cancer.
<b>CLO 5</b>	Elaborate on the infectious and sexually transmitted diseases.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
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1	<p><b>UNIT – I</b></p> <p><b>Basic principles of Cell injury and Adaptation:</b> Introduction, definitions, Homeostasis, Components and Types of Feedback systems, uses 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 &amp; Alkalosis, Electrolyte imbalance</p> <p><b>Basic mechanism involved in the process of inflammation and repair:</b> 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</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Cardiovascular System:</b> Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)</p> <p><b>Respiratory system:</b> Asthma, Chronic obstructive airways diseases.</p> <p><b>Renal system:</b> Acute and chronic renal failure</p>	22.22%	10
3	<p><b>UNIT – III</b></p> <p><b>Haematological Diseases:</b> Iron deficiency, megaloblastic anaemia (Vit B12 and folic acid), sickle cell anaemia, thalassemia, hereditary acquired anaemia, haemophilia</p> <p><b>Endocrine system:</b> Diabetes, thyroid diseases, disorders of sex hormones</p> <p><b>Nervous system:</b> Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.</p> <p><b>Gastrointestinal system:</b> Peptic Ulcer</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p>Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.</p> <p><b>Disease of bones and joints:</b> Rheumatoid arthritis, osteoporosis and gout</p> <p><b>Principles of cancer:</b> classification, etiology and pathogenesis of cancer</p> <p><b>Diseases of bones and joints:</b> Rheumatoid Arthritis, Osteoporosis, Gout</p>	17.77%	8

	<b>Principles of Cancer:</b> Classification, etiology and pathogenesis of Cancer		
<b>5</b>	<b>UNIT – V</b> <b>Infectious diseases:</b> Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections <b>Sexually transmitted diseases:</b> AIDS, Syphilis, Gonorrhoea	<b>15.55 %</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

9. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
10. Harsh Mohan; Textbook of Pathology; 6th edition; India; Jaypee Publications; 2010.
11. Laurence B, Bruce C, Bjorn K.; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
12. 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 edition; united states.
13. William and Wilkins, Baltimore;1991 [1990 printing].
14. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
15. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.

- a. **Course Name:** Computer Applications in Pharmacy  
 b. **Course Code:** BP205T  
 c. **Prerequisite:** Students should have a basic understanding of Computers.  
 d. **Rationale:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various types of application of computers in pharmacy
<b>CLOBJ 2</b>	Know the various types of databases
<b>CLOBJ 3</b>	Know the various applications of databases in pharmacy

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the number system and Know the concept of software and information system
<b>CLO 2</b>	Understand the importance of web technologies and programming languages
<b>CLO 3</b>	Learn the applications of computers in pharmacy
<b>CLO 4</b>	Learn Computers as data analysis in Preclinical development and understand the concept of bioinformatics
<b>CLO 5</b>	Perform experiments to understand the practical applicability of computer in pharmacy

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	10	05	-	35	-	50
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Number system:</b> 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</p> <p><b>Concept of Information Systems and Software:</b> Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project</p>	20 %	06
2	<p><b>UNIT – II</b></p> <p><b>Web technologies:</b> Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database</p>	20 %	06
3	<p><b>UNIT – III</b></p> <p><b>Application of computers in Pharmacy –</b> 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</p>	20 %	06
4	<p><b>UNIT – IV</b></p> <p><b>Bioinformatics:</b> Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.</p>	20 %	06
5	<p><b>UNIT – V</b></p> <p><b>Computers as data analysis in Preclinical development:</b> Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)</p>	20 %	06
	<b>Total</b>	<b>100%</b>	<b>30</b>

**i. Text Book and Reference Book:**

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



2	-	-	2	10	05	-	35	-	50
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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.	33.33 %	10
2	<b>UNIT – II</b> 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)	33.33 %	10
3	<b>UNIT – III</b> Environmental Pollution: Air pollution; Water pollution; Soil pollution	33.33 %	10
	<b>Total</b>	<b>100%</b>	<b>30</b>

#### i. Textbook and Reference Book:

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 Publishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

5. Clark R.S., Marine Pollution, Clarendon 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.

### Semester 3

- a. **Course Name:** Pharmaceutical Organic Chemistry –II
- b. **Course Code:** BP301T
- c. **Prerequisite:** Students should have a background in Biology and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the structure, name and the type of isomerism of the organic compound.
<b>CLOBJ 2</b>	Know the reaction, name the reaction and orientation of reactions.
<b>CLOBJ 3</b>	Understand the account for reactivity/stability of compounds.
<b>CLOBJ 4</b>	Understand the preparation of Organic Compound
<b>CLOBJ 5</b>	Understand the Laboratory Techniques/Oil values/Preparation of Organic Compound.

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study the concept of aromaticity, structure, Reactions and synthesis of Benzene and its derivatives.
<b>CLO 2</b>	Describe the reactions and synthesis of Phenols, aromatic amines and aromatic acids.
<b>CLO 3</b>	Study of fats and oils, reactivity and their quality control evaluation methods.

<b>CLO 4</b>	Explain the stability and reactions of cycloalkanes, polynuclear hydrocarbons.
<b>CLO 5</b>	Synthesize various aromatic organic compounds and derivatives, determine oil values

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Benzene and its derivatives:</b></p> <p>A. Analytical, synthetic and other evidence in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule</p> <p>B. Reactions of benzene - nitration, sulphonation, halogenation reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.</p> <p>C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction.</p> <p>D. Structure and uses of DDT, Saccharin, BHC and Chloramine</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>Phenols</b> - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols.</p>	22.22%	10

	<p><b>Aromatic Amines</b> - Basicity of amines, effect of substituents on basicity and synthetic uses of aryl diazonium salts</p> <p><b>Aromatic Acids</b> –Acidity, effect of substituents on acidity and important reactions of benzoic acid.</p>		
<b>3</b>	<p><b>UNIT – III</b></p> <p><b>Fats and Oils</b></p> <p>d) Fatty acids – reactions.  e) Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.  f) Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT – IV</b></p> <p><b>Polynuclear hydrocarbons:</b></p> <p>c) Synthesis, reactions  d) Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p><b>Cyclo-alkanes</b></p> <p>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</p>	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 textbook 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.

**a. Course Name:** Physical Pharmaceutics-I

**b. Course Code:** BP302T

**c. Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.

**d. Rationale:** The course deals with the various physical and physicochemical properties, and principle 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the designing the dosage forms.
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.

<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	Understand the various Pharmaceuticals Equation and formula and application of the same to derive the effective results.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the solubility aspects of the drugs and various principles involved in it.
<b>CLO 2</b>	Explain the different states of matter and understand the basic principles of various physicochemical properties of drug molecules.
<b>CLO 3</b>	Demonstrate the Surface and interfacial phenomenon of liquid formulations and its importance in designing the dosage forms.
<b>CLO 4</b>	Understand the application of complexation and protein binding and study the concept of pH, buffers, isotonic solutions in pharmacy.
<b>CLO 5</b>	Demonstrate the use of physicochemical properties of drug in the formulation development and evaluation of dosage forms.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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	22.22%	10

	solution temperature and applications. Distribution law, its limitations, and applications		
<b>2</b>	<b>UNIT – II</b> 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	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT – III</b> 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.	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT – IV</b> 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.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> 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.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

5. Marcel Dekker Inc. 6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekker Inc. 7. Physical Pharmaceutics by Ramasamy C and Manavalan R.
6. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimmasetty
7. Physical Pharmaceutics by C.V.S. Subramanyam
8. Test book of Physical Pharmacy, by Gaurav Jain & Roop K. Khar

- a. **Course Name:** Pharmaceutical Microbiology
- b. **Course Code:** BP303T
- c. **Prerequisite:** Students should have a background in Biology, Physics, and Chemistry.

**d. Rationale:** Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand methods of identification, cultivation and preservation of various microorganisms
<b>CLOBJ 2</b>	Understand the importance and implementation of sterilization in pharmaceutical processing and industry
<b>CLOBJ 3</b>	Learn sterility testing of pharmaceutical products.
<b>CLOBJ 4</b>	Carried out microbiological standardization of Pharmaceuticals.
<b>CLOBJ 5</b>	Understand the cell culture technology and its applications in pharmaceutical industries.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand various aspects of microorganisms, their growth and use of microscopes
<b>CLO 2</b>	Understand the various staining techniques to identify the microorganisms and also study the aspects of sterilization
<b>CLO 3</b>	Learn about the Fungi and Viruses along and summarize the disinfection techniques and sterility testing
<b>CLO 4</b>	Planning an aseptic area, study of spoilage and execute the microbiological standardization of Pharmaceuticals
<b>CLO 5</b>	Carry out the practicals to understand the characteristics of microorganisms and assessing antibiotics using aseptic techniques.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p>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 &amp; viable count); Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.</p>	22.22%	10
2	<p><b>UNIT-II</b></p> <p>Identification of bacteria using staining techniques (simple, Gram's &amp; 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.</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p>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 &amp; Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and</p>	22.22%	10
4	<p><b>UNIT-IV</b></p> <p>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.</p>	17.77%	08
5	<p><b>UNIT-V</b></p> <p>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</p>	15.55%	07

	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		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

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
5. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
6. Peppler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions.
7. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
8. Edward: Fundamentals of Microbiology. 12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
9. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

- a. **Course Name:** Pharmaceutical Engineering
- b. **Course Code:** BP 304 T
- c. **Prerequisite:** Students should have a background in Biology, Physics, and Chemistry.
- d. **Rationale:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know various unit operations used in pharmaceutical industries.
<b>CLOBJ 2</b>	To understand the material handling techniques.
<b>CLOBJ 3</b>	To perform various processes involved in pharmaceutical manufacturing process.
<b>CLOBJ 4</b>	To carry out various test to prevent environmental pollution.
<b>CLOBJ 5</b>	To appreciate and comprehend significance of plant lay out design for optimum use of resources.
<b>CLOBJ 6</b>	To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Know about the various unit operations like flow of fluids, size reduction and size separation used in pharmaceutical industries.
<b>CLO 2</b>	Understanding the unit operations like Heat Transfer, Evaporation and Distillation
<b>CLO 3</b>	Demonstration of unit operation like drying and mixing used in pharmaceutical industry.
<b>CLO 4</b>	Gain the knowledge of materials used for pharmaceutical plant construction and understand the processes like filtration and centrifugation.
<b>CLO 5</b>	Demonstrate the practical aspect of various engineering-based unit operations.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme		
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Internal Evaluation</b>	<b>ESE</b>	<b>Total</b>

				<b>MSE</b>	<b>CE</b>	<b>P</b>	<b>Theory</b>	<b>P</b>	
<b>3</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>15</b>	<b>10</b>	-	<b>75</b>	-	<b>100</b>
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Flow of fluids:</b> Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturi-meter, Pitot tube and Roto-meter.</p> <p><b>Size Reduction:</b> Objectives, Mechanisms &amp; 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 &amp; end runner mill.</p> <p><b>Size Separation:</b> Objectives, applications &amp; 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 &amp; elutriation tank.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p>Heat Transfer: Objectives, applications &amp; Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection &amp; radiation. Heat interchangers &amp; heat exchangers.</p> <p><b>Evaporation:</b> 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 &amp; Economy of multiple effect evaporator.</p> <p><b>Distillation:</b> Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation &amp; molecular distillation</p>	22.22%	10

3	<p><b>UNIT – III</b></p> <p><b>Drying:</b> Objectives, applications &amp; mechanism of drying process, measurements &amp; 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.</p> <p><b>Mixing:</b> Objectives, applications &amp; 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 &amp; Silverson Emulsifier.</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Filtration:</b> Objectives, applications, Theories &amp; Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate &amp; frame filter, filter leaf, rotary drum filter, Meta filter &amp; Cartridge filter, membrane filters and Seidtz filter.</p> <p><b>Centrifugation:</b> Objectives, principle &amp; applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge &amp; super centrifuge.</p>	17.77%	08
5	<p><b>UNIT – V</b></p> <p><b>Materials of pharmaceutical plant construction, Corrosion and its prevention:</b> 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.</p>	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. Introduction to chemical engineering – Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson Latest edition.

3. Unit operation of chemical engineering – McCabe 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 IV

- a. **Course Name:** Pharmaceutical Organic Chemistry-III
- b. **Course Code:** BP401T
- c. **Prerequisite:** Students should have a basic understanding of Organic chemistry-I & II.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the methods of preparation and properties of organic compounds
<b>CLOBJ 2</b>	Explain the stereo chemical aspects of organic compounds and stereo chemical reactions
<b>CLOBJ 3</b>	Know the medicinal uses and other applications of organic compounds

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the nomenclature and definitions of isomers and reactions of chiral molecules
<b>CLO 2</b>	Understand the stereo-chemical aspects of organic compounds
<b>CLO 3</b>	Understand nomenclature & classification, preparation and reaction of certain Heterocyclic compounds
<b>CLO 4</b>	Study the reactions of stereoisomers, synthesis and medicinal use of heterocyclic compounds and their derivatives
<b>CLO 5</b>	Study reactions with importance in synthesis (Name reactions).

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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	22.22%	10
2	<b>UNIT – II</b> 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 (Atropoisomeric) and conditions for optical activity. Stereospecific and stereoselective reactions	22.22%	10
3	<b>UNIT – III</b> 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	22.22%	10
4	<b>UNIT – IV</b> 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	17.77%	08
5	<b>UNIT – V</b> Reactions of synthetic importance, Metal hydride reduction (NaBH <sub>4</sub> and LiAlH <sub>4</sub> ), Clemmensen reduction, Birch	15.55%	07

	reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

**a. Course Name:** Medicinal Chemistry-I

**b. Course Code:** BP402T

**c. Prerequisite:** Students should have a basic concept of organic and inorganic chemistry.

**d. Rationale:** 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

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the chemistry of drugs with respect to their pharmacological activity
<b>CLOBJ 2</b>	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
<b>CLOBJ 3</b>	Know the Structural Activity Relationship (SAR) of different class of drugs
<b>CLOBJ 4</b>	Write the chemical synthesis of some drugs
<b>CLOBJ 5</b>	Understand the Preparation of drugs/intermediates and perform assay of drugs

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Introduction to medicinal chemistry, Physicochemical properties of drug in relation to biological action and drug metabolism
<b>CLO 2</b>	Explain and classify Drugs acting on Autonomic Nervous System, Structure activity relationship and synthesis of selective drugs.
<b>CLO 3</b>	Study of Cholinergic neurotransmitters, structure-activity relationship and synthesis of selective drugs.
<b>CLO 4</b>	Explain and classify Drugs acting on Central Nervous System, structure activity relationship and synthesis of selective drugs.
<b>CLO 5</b>	Prepare drugs/intermediates, perform assay of drugs and determine partition coefficient.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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	22.22%	10
2	<b>UNIT – II</b> Drugs acting on Autonomic Nervous System <b>Adrenergic Neurotransmitters:</b> Biosynthesis and catabolism of catecholamine. <b>Adrenergic receptors:</b> (Alpha & Beta) and their distribution.	22.22%	10

	<p><b>Sympathomimetic agents:</b> SAR of Sympathomimetic agents</p> <p>Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. <b>Indirect acting agents:</b> Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. Agents with mixed mechanism: Ephedrine, Metaraminol. Adrenergic Antagonists: Alpha adrenergic blockers: Tolazoline, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.</p> <p><b>Beta adrenergic blockers:</b> SAR of beta blockers, Propranolol, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.</p>		
3	<p><b>UNIT – III</b></p> <p><b>Cholinergic neurotransmitters:</b></p> <p><b>Biosynthesis and catabolism of acetylcholine.</b></p> <p>Cholinergic receptors (Muscarinic &amp; Nicotinic) and their distribution.</p> <p><b>Parasympathomimetic agents:</b> SAR of Parasympathomimetic agents.</p> <p><b>Direct acting agents:</b> Acetylcholine, Carbachol, Bethanechol, Methacholine, Pilocarpine.</p> <p><b>Indirect acting/ Cholinesterase inhibitors</b> (Reversible &amp; Irreversible): Physostigmine, Neostigmine, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorophate, Echothiophate iodide, Parathion, Malathion.</p> <p><b>Cholinesterase reactivator:</b> Pralidoxime chloride.</p> <p><b>Cholinergic Blocking agents:</b> SAR of cholinolytic agents</p> <p>Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide.</p> <p><b>Synthetic cholinergic blocking agents:</b> 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.</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Drugs acting on Central Nervous System</b></p> <p><b>Sedatives and Hypnotics:</b> Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem</p>	17.77%	08

	<p><b>Barbiturates:</b> SAR of barbiturates, Barbitol, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital.</p> <p><b>Miscellaneous:</b> Amides &amp; imides: Glutethimide; Alcohol &amp; their carbamate derivatives: Meprobamate, Ethchlorvynol; Aldehyde &amp; their derivatives: Triclofos sodium, Paraldehyde. <b>Antipsychotics:</b> Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.</p> <p><b>Fluro-buterophenones:</b> Haloperidol, Droperidol, Risperidone.</p> <p><b>Beta amino ketones:</b> Molindone hydrochloride. Benzamides: Sulpieride.</p> <p><b>Anticonvulsants:</b> SAR of Anticonvulsants, mechanism of anticonvulsant action.</p> <p><b>Barbiturates:</b> Phenobarbitone, Methabarbital. Hydantoins: Phenytoin, Mephentyoin, Ethotoin Oxazolindione diones: Trimethadione, Paramethadione Succinimides: Phensuximide, Methsuximide, Ethosuximide, Urea and monoacylureas: Phenacemide, Carbamazepine Benzodiazepines: Clonazepam.</p> <p><b>Miscellaneous:</b> Primidone, Valproic acid, Gabapentin, Felbamate</p>		
5	<p><b>UNIT – V</b></p> <p><b>Drugs acting on Central Nervous System</b></p> <p><b>General anesthetics:</b> Inhalation anesthetics: Halothane, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.</p> <p><b>Ultra short acting barbiturates:</b> Methohexital sodium, Thiamylal sodium, Thiopental sodium. Dissociative anaesthetics: Ketamine hydrochloride.</p> <p><b>Narcotic and non-narcotic analgesics:</b> 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.</p> <p><b>Narcotic antagonists:</b> Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.</p> <p><b>Anti-inflammatory agents:</b> Sodium salicylate, Aspirin, Mefenamic acid, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.</p>	15.55%	07

	<b>Total</b>	<b>100%</b>	<b>45</b>
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**i. Text Book and Reference Book:**

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.

a. **Course Name:** Physical Pharmaceutics II

b. **Course Code:** BP403T

c. **Prerequisite:** Students should have a basic understanding of Dosage forms and its formulation.

d. **Rationale:** The course deals with the various physical and physicochemical properties, and principle's 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the
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	designing the dosage forms
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	To understand the practical aspects of physico chemical properties in dosage form design.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Compare properties, formulate, and evaluate coarse and colloidal dispersions
<b>CLO 2</b>	Illustrate the concept of Rheology and contrast the deformation of solids
<b>CLO 3</b>	Classify micromeritic properties of drug molecules in development and characterization of dosage forms.
<b>CLO 4</b>	Explain the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
<b>CLO 5</b>	Practical aspects of physicochemical properties in dosage form design.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Colloidal dispersions:</b> Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical	22.22 %	10

	properties. Effect of electrolytes, coacervation, peptization & protective action.		
<b>2</b>	<p><b>UNIT – II</b></p> <p><b>Rheology:</b> 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</p> <p><b>Deformation of solids:</b> Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus</p>	<b>22.22 %</b>	<b>10</b>
<b>3</b>	<p><b>UNIT – III</b></p> <p><b>Coarse dispersion:</b> 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.</p>	<b>22.22 %</b>	<b>10</b>
<b>4</b>	<p><b>UNIT – IV</b></p> <p><b>Micromeritics:</b> 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 &amp; flow properties.</p>	<b>17.77 %</b>	<b>08</b>
<b>5</b>	<p><b>UNIT – V</b></p> <p>Drug stability: Reaction kinetics: zero, pseudo-zero, first &amp; 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 &amp; general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis &amp; oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention</p>	<b>15.55 %</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

**b. Course Code: BP404T**

**c. Prerequisite:** Students should have a background in Biology, Human Anatomy & Physiology and chemistry.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the pharmacological actions of different categories of drugs
<b>CLOBJ 2</b>	Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
<b>CLOBJ 3</b>	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases
<b>CLOBJ 4</b>	Observe the effect of drugs on animals by simulated experiments
<b>CLOBJ 5</b>	Appreciate correlation of pharmacology with other bio medical sciences

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacology and pharmacokinetics
<b>CLO 2</b>	Understand the pharmacological actions of drugs acting on Autonomic Nervous System, Structure activity relationship and illustrate synthesis of selective drugs.
<b>CLO 3</b>	Understand the pharmacology of drugs acting on peripheral nervous system
<b>CLO 4</b>	Explain the treatments of various neurodegenerative and psychological diseases of central nervous system.
<b>CLO 5</b>	Study of the basics of pharmacological experiments, ethics, and observe the effect of drugs on animals by simulated experiments

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	2	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>General Pharmacology</b></p> <p><b>Introduction to Pharmacology-</b> Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and noncompetitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.</p> <p><b>Pharmacokinetics-</b> Membrane transport, absorption, distribution, metabolism, and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination</p>	17.77%	08
2	<p><b>UNIT – II</b></p> <p><b>General Pharmacology</b></p> <p><b>Pharmacodynamics-</b> 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.</p> <p><b>Adverse drug reactions.</b></p> <p><b>Drug interactions</b> (pharmacokinetic and pharmacodynamic)</p> <p><b>Drug discovery and clinical evaluation of new drugs</b> -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.</p>	26.67%	12
3	<p><b>UNIT – III</b></p> <p><b>Pharmacology of drugs acting on peripheral nervous system</b></p> <p>Organization and function of ANS. Neurohumoral transmission-transmission and classification of neurotransmitters. Parasympathomimetic, Parasympatholytic, Sympathomimetics, sympatholytic. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). Local anaesthetic agents. Drugs used in myasthenia gravis and glaucoma</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>Pharmacology of drugs acting on central nervous system</b></p>		

	Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. General anesthetics and preanesthetics. Sedatives, hypnotics and centrally acting muscle relaxants. Anti-epileptics; Alcohols and disulfiram.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT – V</b> <b>Pharmacology of drugs acting on central nervous system</b> Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. Drugs used in Parkinsons disease and Alzheimer’s disease. CNS stimulants and nootropics. Opioid analgesics and antagonists. Drug addiction, drug abuse, tolerance and dependence.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale’s Pharmacology, Churchill 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
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. VallabhPrakashan,

- a. **Course Name:** Pharmacognosy and Phytochemistry-I
- b. **Course Code:** BP405T
- c. **Prerequisite:** Students should have a basic concept of Botany, Biology and Chemistry.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know the techniques in the cultivation and production of crude drugs
<b>CLOBJ 2</b>	To know the crude drugs, their uses and chemical nature
<b>CLOBJ 3</b>	Know the evaluation techniques for the herbal drugs
<b>CLOBJ 4</b>	To carry out the microscopic and morphological evaluation of crude drugs

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacognosy and quality control parameters of herbal drugs
<b>CLO 2</b>	Make use of the techniques in the cultivation, collection, processing, and storage of herbal drugs
<b>CLO 3</b>	Extend the knowledge of plant tissue culture and study of biological source, chemical nature and uses of drugs of natural origin
<b>CLO 4</b>	Develop the pharmacogenetic profile of plant metabolites and role of pharmacognosy in various systems of medicine
<b>CLO 5</b>	Carry out the experiments on the microscopic and morphological characteristics of crude drugs

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Introduction to Pharmacognosy:</b>                      (a) Definition, history, scope and development of Pharmacognosy                      (b) Sources of Drugs – Plants, Animals, Marine &amp; Tissue culture                      (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).  <b>Classification of drugs:</b> Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and serotaxonomical classification of drugs.  <b>Quality control of Drugs of Natural Origin:</b> 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, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida</p>	22.22%	10
2	<p><b>UNIT – II</b>  <b>Cultivation, Collection, Processing and storage of drugs of natural origin:</b>                      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</p>	22.22%	10
3	<p><b>UNIT – III</b>  <b>Plant tissue culture:</b> Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines</p>	15.55%	07
4	<p><b>UNIT – IV</b>  <b>Pharmacognosy in various systems of medicine:</b></p>		

	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	22.22%	10
5	<b>UNIT – V</b> <b>Study of biological source, chemical nature, and uses of drugs of natural origin containing following drugs</b> <b>Plant Products:</b> <b>Fibers</b> - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens <b>Primary metabolites:</b> 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: <b>Carbohydrates:</b> Acacia, Agar, Tragacanth, Honey, Proteins and Enzymes: Gelatine, casein, proteolytic enzymes (Papain, bromelain, serrati peptidase, urokinase, streptokinase, pepsin). Lipids (Waxes, fats, fixed oils): Castor oil, Chaulmoogra oil, Wool Fat, Beeswax <b>Marine Drugs:</b> Novel medicinal agents from marine sources	17.77%	08
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Textbook and Reference Book:**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988
3. Textbook of Pharmacognosy by T.E. Wallis.
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Textbook 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 5

- a. **Course Name:** Medicinal chemistry-II
- b. **Course Code:** BP501T
- c. **Prerequisite:** Students should have the basic knowledge of Pharmaceutical Organic Chemistry and Pharmacology
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the chemistry of drugs with respect to their pharmacological activity
<b>CLOBJ 2</b>	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
<b>CLOBJ 3</b>	Know the Structural Activity Relationship of different class of drugs
<b>CLOBJ 4</b>	Study the chemical synthesis of selected drugs

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study of the chemistry of Antihistaminic and Anti-neoplastic agents along with the classification and SAR and synthesis of selective drugs.
<b>CLO 2</b>	Describe the chemistry of Anti-anginal, Diuretics and Anti-hypertensive agents along with the classification and SAR and synthesis of selective drugs.
<b>CLO 3</b>	Understand the chemistry of the drugs used in cardiovascular diseases along with the classification and SAR and synthesis of selective drugs.

<b>CLO 4</b>	Explain the chemistry of the drugs acting on Endocrine system along with the classification and SAR and synthesis of selective drugs.
<b>CLO 5</b>	Explain the chemistry of Antidiabetic agents, local anesthetics and outline other miscellaneous drugs along with the SAR and synthesis of selective drugs.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT- I</b> <b>Antihistaminic agents:</b> Histamine, receptors and their distribution in the human body <b>H1-antagonists:</b> Diphenhydramine hydrochloride, Dimenhydrinate, Doxylamines succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride, Phenidamine tartarate, Promethazine hydrochloride, Trimепразине tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium. <b>H2-antagonists:</b> Cimetidine, Famotidine, Ranitidin. <b>Gastric Proton pump inhibitors:</b> Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole <b>Anti-neoplastic agents:</b> <b>Alkylating agents:</b> Meclorothamine, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa <b>Antimetabolites:</b> Mercaptopurine, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate, Azathioprine <b>Antibiotics:</b> Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin <b>Plant products:</b> Etoposide, Vinblastin sulphate, Vincristin sulphate <b>Miscellaneous:</b> Cisplatin, Mitotane.	22.22%	10
2	<b>UNIT – II</b> <b>Anti-anginal:</b>	22.22%	10

	<p><b>Vasodilators:</b> Amyl nitrite, Nitroglycerin, Pentaerythritol tetranitrate, Isosorbide dinitrite, Dipyridamole.</p> <p><b>Calcium channel blockers:</b> Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.</p> <p><b>Diuretics:</b> Carbonic anhydrase inhibitors: Acetazolamide, Methazolamide, Dichlorphenamide.</p> <p><b>Thiazides:</b> Chlorthiazide, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol</p> <p><b>Anti-hypertensive Agents:</b> Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.</p>		
3	<p><b>UNIT- III</b></p> <p><b>Anti-arrhythmic Drugs:</b> Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.</p> <p><b>Anti-hyperlipidemic agents:</b> Clofibrate, Lovastatin, Cholesteramine and Cholestipol</p> <p><b>Coagulant &amp; Anticoagulants:</b> Menadione, Acetomenadione, Warfarin, Anisindione, clopidogrel</p> <p><b>Drugs used in Congestive Heart Failure:</b> Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.</p>	22.22%	10
4	<p><b>UNIT- IV</b></p> <p><b>Drugs acting on Endocrine system</b> Nomenclature, Stereochemistry and metabolism of steroids</p> <p><b>Sex hormones:</b> Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrone, Diethyl stilbestrol.</p> <p><b>Drugs for erectile dysfunction:</b> Sildenafil, Tadalafil.</p> <p><b>Oral contraceptives:</b> Mifepristone, Norgestrel, Levonorgestrol</p> <p><b>Corticosteroids:</b> Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone</p> <p><b>Thyroid and antithyroid drugs:</b> L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.</p>	17.77%	8
5	<p><b>UNIT – V</b></p> <p><b>Antidiabetic agents:</b> Insulin and its preparations, Sulfonyl ureas: Tolbutamide, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acarbose, Voglibose.</p> <p><b>Local Anesthetics:</b> SAR of Local anesthetics</p> <p><b>Benzoic Acid derivatives;</b> Cocaine, Hexylcaine, Mepylcaine, Cyclomethycaine, Piperocaine.</p> <p><b>Amino Benzoic acid derivatives:</b> Benzocaine, Butamben, Procaine, Butacaine, Propoxycaine, Tetracaine, Benoxinate.</p> <p><b>Lidocaine/Anilide derivatives:</b> Lignocaine, Mepivacaine, Prilocaine, Etidocaine.</p>	15.55	7

	<b>Miscellaneous:</b> Phenacaine, Dipiperodon, Dibucaine.		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I. Vogel.

**a. Course Name:** Industrial Pharmacy-I

**b. Course Code:** BP502T

**c. Prerequisite:** Students should have the basic knowledge of pharmaceutical science of dosage forms.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various pharmaceutical dosage forms and their manufacturing techniques.
<b>CLOBJ 2</b>	Know various considerations in development of pharmaceutical dosage forms

<b>CLOBJ 3</b>	Formulate solid, liquid and semisolid dosage forms and evaluate them for their
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the physicochemical characteristics of drug substances and classify the considerations in development of tablets
<b>CLO 2</b>	Study and compare considerations in development of Liquid orals, Capsules and pellets
<b>CLO 3</b>	Outline various considerations in development of Parenteral Products and Ophthalmic Preparations
<b>CLO 4</b>	Know and demonstrate various considerations in development of cosmetics and Pharmaceutical Aerosols and understand the Packaging Materials Science
<b>CLO 5</b>	Prepare and evaluate pharmaceutical dosage forms

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Preformulation Studies:</b> Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. <b>a. Physical properties:</b> Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism <b>b. Chemical Properties:</b> Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs	15.55%	7

	& 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.		
2	<p><b>UNIT-II</b></p> <p><b>Tablets:</b></p> <p>a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.</p> <p>b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.</p> <p>c. Quality control tests: In process and finished product tests</p> <p><b>Liquid orals:</b> Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p><b>Capsules:</b></p> <p>a. <i>Hard gelatine capsules:</i> Introduction, Production of hard gelatine capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatine capsules, manufacturing defects. In process and final product quality control tests for capsules.</p> <p>b. <i>Soft gelatine capsules:</i> 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 gelatine capsules and their applications.</p> <p><b>Pellets:</b> Introduction, formulation requirements, palletisation process, Equipments for manufacture of pellets</p>	17.77%	8
4	<p><b>UNIT- IV</b></p> <p><b>Parenteral Products:</b></p> <p>a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity</p> <p>b. Production procedure, production facilities and controls, aseptic processing</p> <p>c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.</p> <p>d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.</p> <p><b>Ophthalmic Preparations:</b> Introduction, formulation considerations; formulation of eye drops, eye ointments</p>	22.22%	10

	and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations		
5	<b>UNIT – V</b> <b>Cosmetics:</b> Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. <b>Pharmaceutical Aerosols:</b> Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. <b>Packaging Materials Science:</b> 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. <b>Miscellaneous:</b> Phenacaine, Dipiperodon, Dibucaine.	22.22%	10
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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, 5th edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

- a. **Course Name:** Pharmacology-II  
 b. **Course Code:** BP503T  
 c. **Prerequisite:** students should have the basic knowledge of anatomy and physiology and chemistry.  
 d. **Rationale:** 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.  
 e. **Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting directly on the cardiovascular system
<b>CLO 2</b>	Compare the pharmacology of the drugs acting indirectly on the cardiovascular and urinary system
<b>CLO 3</b>	Explain the pharmacology of autocooids and related drugs.
<b>CLO 4</b>	Illustrate the pharmacology of drugs acting on the endocrine system and study of the basic concept of bioassay.
<b>CLO 5</b>	Demonstrate the effect of various drugs on isolated tissues preparation and on whole animals by stimulated experiments.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

<b>Sr. No</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<b>UNIT-I</b> <b>1. Pharmacology of drugs acting on cardio vascular system</b> 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.	<b>22.22%</b>	<b>10</b>
<b>2</b>	<b>UNIT-II</b> <b>1. Pharmacology of drugs acting on cardio vascular system</b> a. Drug used in the therapy of shock. b. Hematinics, coagulants and anticoagulants. c. Fibrinolytics and anti-platelet drugs d. Plasma volume expanders <b>2. Pharmacology of drugs acting on urinary system</b> a. Diuretics b. Anti-diuretics.	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT-III</b> <b>3. Autocoids and related drugs</b> 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	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT- IV</b> <b>5. Pharmacology of drugs acting on endocrine system</b> 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 lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. <b>Ophthalmic Preparations:</b> Introduction, formulation considerations; formulation of eye drops, eye ointments and	<b>17.77%</b>	<b>8</b>

	eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations		
<b>5</b>	<b>UNIT-V</b> <b>5. Pharmacology of drugs acting on endocrine system</b> a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. <b>6. Bioassay</b> a. Principles and applications of bioassay. b. Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill 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
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.

- a. **Course Name:** Pharmacognosy and Phytochemistry- II
- b. **Course Code:** BP504T
- c. **Prerequisite:** students should have the basic knowledge of Botany and Chemistry
- d. **Rationale:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites is 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
<b>CLOBJ 2</b>	To understand the herbal drug interactions
<b>CLOBJ 3</b>	To understand the preparation and development of herbal formulation.
<b>CLOBJ 4</b>	To carryout isolation and identification of phytoconstituents

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Identify the basic metabolic pathways and study the basics of Phytochemistry
<b>CLO 2</b>	Summarise and understand the pharmacognostic profile of Secondary plant metabolites and their commercial applications.
<b>CLO 3</b>	Develop the isolation, identification, utilization, and estimation of phytoconstituents.
<b>CLO 4</b>	Learn the modern extraction methods, spectroscopic and chromatographic techniques for crude drugs
<b>CLO 5</b>	Make use of the practical aspects of identification, isolation, and analysis of crude drugs.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Metabolic pathways in higher plants and their determination</b>                      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.</p>	15.55%	7
2	<p><b>UNIT-II</b>                      General introduction, composition, chemistry &amp; chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:  <b>Alkaloids:</b> Vinca, Rauwolfia, Belladonna, Opium,  <b>Phenylpropanoids and Flavonoids:</b> Lignans, Tea, Ruta  <b>Steroids, Cardiac Glycosides &amp; Triterpenoids:</b> Liquorice, Dioscorea, Digitalis  <b>Volatile oils:</b> Mentha, Clove, Cinnamon, Fennel, Coriander,  <b>Tannins:</b> Catechu, Pterocarpus  <b>Resins:</b> Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony  <b>Glycosides:</b> Senna, Aloes, Bitter Almond  <b>Iridoids, Other terpenoids &amp; Naphthaquinones:</b> Gentian, Artemisia, taxus, carotenoids</p>	31.11%	14
3	<p><b>UNIT-III</b>                      Isolation, Identification and Analysis of Phytoconstituents                      a) Terpenoids: Menthol, Citral, Artemisin</p>	13.33%	6

	b) Glycosides: Glycyrrhetic acid & Rutin c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine d) Resins: Podophyllotoxin, Curcumin		
<b>4</b>	<b>UNIT-IV</b> Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	<b>17.77%</b>	<b>8</b>
<b>5</b>	<b>UNIT-V</b> <b>Basics of Phytochemistry</b> Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

**a. Course Name:** Pharmaceutical Jurisprudence

**b. Course Code:** BP505T

**c. Prerequisite:** Students should have the basic knowledge on important legislations

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

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
<b>CLOBJ 2</b>	Various Indian pharmaceutical Acts and Laws
<b>CLOBJ 3</b>	The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLOBJ 4</b>	The code of ethics during the pharmaceutical practice

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the Drugs and Cosmetics Act, 1940 and its rules 1945 with specific emphasis on Import, Manufacture of drugs and Conditions for grant of license
<b>CLO 2</b>	Study the Drugs and Cosmetics Act, 1940 and its rules 1945 with specific emphasis on schedules, Labelling & Packing of drugs, Administration of the Act and Rules
<b>CLO 3</b>	Gain the knowledge of various Indian pharmaceutical Acts and Laws along with offences and penalties
<b>CLO 4</b>	Study the features of Drugs and Magic Remedies Act and Prevention of Cruelty to animals Act-1960 and also the details of national pharmaceutical authority
<b>CLO 5</b>	Describe the pharmaceutical legislations and IPR and Code of Pharmaceutical ethics during the pharmaceutical practice

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Drugs and Cosmetics Act, 1940 and its rules 1945:</b> 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.	22.22%	10

2	<p><b>UNIT-II</b> Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F &amp; DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties. Labelling &amp; 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</p>	22.22%	10
3	<p><b>UNIT-III</b> <b>Pharmacy Act –1948:</b> Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties <b>Medicinal and Toilet Preparation Act –1955:</b> Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent &amp; Proprietary Preparations. Offences and Penalties. <b>Narcotic Drugs and Psychotropic substances Act-1985 and Rules:</b> Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic &amp; 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</p>	22.22%	10
4	<p><b>UNIT-IV</b> <b>Study of Salient Features of Drugs and Magic Remedies Act and its rules:</b> Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties <b>Prevention of Cruelty to animals Act-1960:</b> 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 <b>National Pharmaceutical Pricing Authority:</b> 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)</p>	17.77%	8
5	<p><b>UNIT-V</b> <b>Pharmaceutical Legislations</b> – A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee</p>	15.55%	7

	<b>Code of Pharmaceutical ethics</b> Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath <b>Medical Termination of Pregnancy Act</b> <b>Right to Information Act</b> <b>Introduction to Intellectual Property Rights (IPR)</b>		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-byM.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)

**Semester 6**

**a. Course Name:** Medicinal chemistry-III

**b. Course Code:** BP601T

**c. Prerequisite:** Students should have the basic knowledge of anatomy physiology and organic chemistry

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the importance of drug design and different techniques of drug design.
<b>CLOBJ 2</b>	Understand the chemistry of drugs with respect to their biological activity.
<b>CLOBJ 3</b>	Know the metabolism, adverse effects and therapeutic value of drugs.
<b>CLOBJ 4</b>	Know the importance of SAR of drugs.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain history, nomenclature, stereochemistry chemical degradation, classification and SAR of $\beta$ -Lactam, Aminoglycosides and Tetracyclines antibiotics
<b>CLO 2</b>	Study the MOA, classification of Macrolide, Antimalarials and miscellaneous drugs with the SAR, synthesis of selective drugs and prodrug concept
<b>CLO 3</b>	Describe the MOA, classification of Anti-tubercular, UTI, anti-infective and Antiviral agents with the SAR and synthesis of selective drugs.
<b>CLO 4</b>	Study the details of Antifungal, Anthelmintics, Sulphonamides and Sulfones and other antimicrobial agents with the SAR and synthesis of selective drugs. Also understand the basic concept of drug design and combinatorial chemistry.
<b>CLO 5</b>	Synthesize drugs and intermediates, perform assay and determine the physicochemical properties of drugs by using drug design software

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

		4	2			15		35	50
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b>  <b>Antibiotics</b>            Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.  <b>β-Lactam antibiotics:</b> Penicillin, Cephalosporins, β-Lactamase inhibitors, Monobactams  <b>Aminoglycosides:</b> Streptomycin, Neomycin, Kanamycin  <b>Tetracyclines:</b> Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline</p>	22.22%	10
2	<p><b>UNIT – II</b>  <b>Antibiotics</b>            Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.  <b>Macrolide:</b> Erythromycin Clarithromycin, Azithromycin.  <b>Miscellaneous:</b> Chloramphenicol, Clindamycin.  <b>Prodrugs:</b> Basic concepts and application of prodrugs design.  <b>Antimalarials:</b> Etiology of malaria.  <b>Quinolines:</b> SAR, Quinine sulphate, Chloroquine, Amodiaquine, Primaquine phosphate, Pamaquine, Quinacrine hydrochloride, Mefloquine.  <b>Biguanides and dihydro triazines:</b> Cycloguanil pamoate, Proguanil.  <b>Miscellaneous:</b> Pyrimethamine, Artesunate, Artemether, Atovaquone</p>	22.22%	10
3	<p><b>UNIT – III</b>  <b>Anti-tubercular Agents</b>  <b>Synthetic anti tubercular agents:</b> Isoniazid, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.  <b>Anti tubercular antibiotics:</b> Rifampicin, Rifabutin, Cycloserine, Streptomycin, Capreomycin sulphate.  <b>Urinary tract anti-infective agents</b></p>	22.22%	10

	<p><b>Quinolones:</b> SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin</p> <p><b>Miscellaneous:</b> Furazolidine, Nitrofurantoin, Methanamine.</p> <p><b>Antiviral agents:</b> Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.</p>		
4	<p><b>UNIT- IV</b></p> <p><b>Antifungal agents:</b> <b>Antifungal antibiotics:</b> Amphotericin-B, Nystatin, Natamycin, Griseofulvin. <b>Synthetic Antifungal agents:</b> Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate. <b>Anti-protozoal Agents:</b> Metronidazole, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. <b>Anthelmintics:</b> Diethylcarbamazine citrate, Thiabendazole, Mebendazole, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin. <b>Sulphonamides and Sulfones</b> Historical development, chemistry, classification and SAR of <b>Sulfonamides:</b> Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide, Sulphapyridine, Sulfamethoxazole, Sulphadiazine, Mefenide acetate, Sulfasalazine. <b>Folate reductase inhibitors:</b> Trimethoprim, Cotrimoxazole. <b>Sulfones:</b> Dapsone.</p>	17.77%	8
5	<p><b>UNIT – V</b></p> <p><b>Introduction to Drug Design</b> Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. <b>Combinatorial Chemistry:</b> Concept and applications chemistry: solid phase and solution phase synthesis</p>	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

i. **Text Book and Reference Book:**

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 Marcel Dekker Series, Vol 107.

a. **Course Name:** Pharmacology-III

b. **Course Code:** BP602T

c. **Prerequisite:** Students should have the basic knowledge of anatomy physiology and chemistry

d. **Rationale:** 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

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
<b>CLOBJ 2</b>	Comprehend the principles of toxicology and treatment of various poisonings
<b>CLOBJ 3</b>	Appreciate correlation of pharmacology with related medical sciences.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting on respiratory system and gastrointestinal tract system.
<b>CLO 2</b>	Compare the principles of chemotherapy and study of the mechanism of action of antibiotics
<b>CLO 3</b>	Demonstrate the pharmacology of various chemotherapeutic agents.
<b>CLO 4</b>	Illustrate pharmacology of drugs acting on immune system and learn the principles of toxicology and chrono pharmacology
<b>CLO 5</b>	Practicality understands the pyrogen testing, conduct toxicity studies and apply biostatistics.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>1. Pharmacology of drugs acting on Respiratory system</b></p> <p>a. Anti -asthmatic drugs            b. Drugs used in the management of COPD            c. Expectorants and antitussives            d. Nasal decongestants            e. Respiratory stimulants</p> <p><b>2. Pharmacology of drugs acting on the Gastrointestinal Tract</b></p> <p>a. Antiulcer agents.            b. Drugs for constipation and diarrhoea.            c. Appetite stimulants and suppressants.            d. Digestants and carminatives.            e. Emetics and anti-emetics.</p>	22.22%	10
2	<p><b>UNIT – II</b></p> <p><b>3. Chemotherapy</b></p> <p>a. General principles of chemotherapy.            b. Sulfonamides and cotrimoxazole.            c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides</p>	22.22%	10
3	<p><b>UNIT- III</b></p> <p><b>3. Chemotherapy</b></p> <p>a. Antitubercular agents            b. Antileprotic agents            c. Antifungal agents            d. Antiviral drugs            e. Anthelmintics            f. Antimalarial drugs            g. Antiamoebic agents</p>	22.22%	10
4	<p><b>UNIT – IV</b></p> <p><b>3. Chemotherapy</b></p> <p>l. Urinary tract infections and sexually transmitted diseases.            m. Chemotherapy of malignancy.</p> <p><b>4. Immunopharmacology</b></p> <p>a. Immunostimulants            b. Immunosuppressant            Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars</p>	17.77%	8
5	<p><b>UNIT – V</b></p> <p><b>5. Principles of toxicology</b></p>	15.55%	7

	<p>a. Definition and basic knowledge of acute, subacute and chronic toxicity.</p> <p>b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity</p> <p>c. General principles of treatment of poisoning</p> <p>d. Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning.</p> <p><b>6. Chrono pharmacology</b></p> <p>a. Definition of rhythm and cycles.</p> <p>b. Biological clock and their significance leading to chronotherapy.</p>		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill 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.

- a. **Course Name:** Herbal Drug Technology
- b. **Course Code:** BP603T
- c. **Prerequisite:** Students should have the basic knowledge of Pharmacognosy and technology.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand raw material as source of herbal drugs from cultivation to herbal drug product
<b>CLOBJ 2</b>	Know the WHO and ICH guidelines for evaluation of herbal drugs
<b>CLOBJ 3</b>	Know the herbal cosmetics, natural sweeteners, nutraceuticals
<b>CLOBJ 4</b>	Appreciate patenting of herbal drugs, GMP.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Make a use of raw material as source of herbal drugs from cultivation to herbal drug product & ISM formulations.
<b>CLO 2</b>	Learn the general aspects of herbal industry, Schedule T, Nutraceuticals & know about the interaction of herbs with drugs and food.
<b>CLO 3</b>	Demonstrate the Natural excipients & herbal formulations.
<b>CLO 4</b>	Apply the WHO & ICH guidelines for the evaluation of herbal drugs, Indian patenting and regulatory requirements.
<b>CLO 5</b>	Construct the practical knowledge of determination of plant Metabolites and preparation & standardization of herbal formulations.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b></p> <p><b>Herbs as raw materials</b>                      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</p> <p><b>Biodynamic Agriculture</b>                      Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.</p> <p><b>Indian Systems of Medicine</b>                      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.</p>	24.44%	11
2	<p><b>UNIT – II</b></p> <p><b>Nutraceuticals</b>                      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</p>	15.55%	7

	<b>Herbal-Drug and Herb-Food Interactions:</b> General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.		
3	<b>UNIT- III</b> <b>Herbal Cosmetics</b> 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. <b>Herbal excipients:</b> Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. <b>Herbal formulations:</b> Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes	22.22%	10
4	<b>UNIT- IV</b> <b>Evaluation of Drugs</b> WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. <b>Patenting and Regulatory requirements of natural products:</b> 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. <b>Regulatory Issues</b> - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	22.22%	10
5	<b>UNIT – V</b> <b>General Introduction to Herbal Industry</b> 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. <b>Schedule T – Good Manufacturing Practice of Indian systems of medicine</b> Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and records	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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.

- a. **Course Name:** Biopharmaceutics and Pharmacokinetics
- b. **Course Code:** BP604T
- c. **Prerequisite:** Students should have the basic knowledge of pharmaceutics and pharmacology.
- d. **Rationale:** 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 raised therein.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
<b>CLOBJ 2</b>	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
<b>CLOBJ 3</b>	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
<b>CLOBJ 4</b>	Understand various pharmacokinetic parameters, their significance & applications.

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study the biopharmaceutics of drug. Absorption and its mechanism.
<b>CLO 2</b>	Understand the biopharmaceutics of drug distribution, metabolism, excretion, and elimination.
<b>CLO 3</b>	Demonstrate an understanding of the concepts of bioavailability and bioequivalence of drug products and their significance.
<b>CLO 4</b>	Explain the concept of pharmacokinetics. and do the calculations of one compartment- open model.
<b>CLO 5</b>	Illustrate the knowledge of the basic concepts of multi-compartment modelling and non-linearity in Pharmacokinetics of the drug and apply the pharmacokinetic principles.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> <b>Introduction Biopharmaceutics</b> <b>To Absorption;</b> Mechanisms of drug absorption through GIT, factors influencing drug absorption through GIT, absorption of drug from Non per oral extra-vascular routes, <b>Distribution</b> 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	22.22%	10
2	<b>UNIT – II</b> <b>Elimination:</b> 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 <b>Bioavailability and Bioequivalence:</b> Definition and Objectives of bioavailability, absolute and relative	22.22%	10

	bioavailability, measurement of bioavailability, <i>in-vitro</i> drug dissolution models, <i>in-vitro-in-vivo</i> correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.		
3	<b>UNIT- III</b> <b>Pharmacokinetics:</b> 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 - $KE$ , $t_{1/2}$ , $V_d$ , $AUC$ , $K_a$ , $Cl_t$ and $CLR$ - definitions methods of eliminations, understanding of their significance and application	22.22%	10
4	<b>UNIT- IV</b> <b>Multicompartment models:</b> Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.	17.77%	8
5	<b>UNIT – V</b> <b>Nonlinear Pharmacokinetics:</b> a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.	15.55%	7
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 International edition. USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal, Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: ByMilo Gibaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, ByMilo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: ByMalcolm Rowland and

9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, 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, ByMack Publishing Company, Pennsylvania

**a. Course Name:** Pharmaceutical Biotechnology

**b. Course Code:** BP605T

**c. Prerequisite:** students should have the basic knowledge of microbiology and biochemistry.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
<b>CLOBJ 2</b>	Genetic engineering applications in relation to production of pharmaceuticals
<b>CLOBJ 3</b>	Importance of Monoclonal antibodies in Industries
<b>CLOBJ 4</b>	Appreciate the use of microorganisms in fermentation technology

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Illustrate the role of enzyme biotechnology and microbes in protein engineering, emphasizing biosensors applications.
<b>CLO 2</b>	Explain the importance of rDNA technology in genetic engineering in relation to production of biopharmaceuticals, demonstrate the role of cloning vectors, and PCR technology,
<b>CLO 3</b>	Show the immunity and its effect on body after infection. Gain the knowledge of preparation, standardization, and storage of vaccines. Recognize importance of hybridoma techniques and explain blood products
<b>CLO 4</b>	Outline the blotting techniques, emphasizing the importance of microbial genetics, the basics of Mutation, microbial biotransformation, and its applications.
<b>CLO 5</b>	Design of fermenters and its different types, demonstrate the production of pharmaceuticals by fermentation techniques, and illustrate the collection and processing of blood products.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT – I</b> 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.	22.22%	10
2	<b>UNIT – II</b> 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	22.22%	10
3	<b>UNIT- III</b> Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications g) Blood products and Plasma Substitutes.	22.22%	10
4	<b>UNIT- IV</b> 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.	17.77%	8
5	<b>UNIT – V</b>	15.55%	7

	a) Fermentation methods and general requirements, study of media, equipment, 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 Substitutes.		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: 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 DelhiPublishing Company, Pennsylvania 1989.

a. **Course Name:** Pharmaceutical Quality Assurance

b. **Course Code:** BP606T

c. **Prerequisite:** Students should have the basic knowledge of analysis and chemistry.

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the cGMP aspects in a pharmaceutical industry
<b>CLOBJ 2</b>	Appreciate the importance of documentation
<b>CLOBJ 3</b>	Understand the scope of quality certifications applicable to pharmaceutical industries
<b>CLOBJ 4</b>	Understand the responsibilities of QA & QC departments

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Illustrate the Quality Certifications as applicable to pharmaceutical industries
<b>CLO 2</b>	Recall the organizational and personal responsibilities, details of pharmaceutical industry premises, Equipment and raw materials in pharma industries.
<b>CLO 3</b>	Learn the Good Laboratory Practices and Quality Control aspects in pharmaceutical industry
<b>CLO 4</b>	Acquire and explain the knowledge of Importance of complaints and documentation in Pharmaceutical Industry.
<b>CLO 5</b>	Gain the knowledge of Calibration and Validation in Pharmaceutical Quality Management

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT – I</b>  <b>Quality Assurance and Quality Management concepts:</b> Definition and concept of Quality control, Quality assurance and GMP  <b>Total Quality Management (TQM):</b> Definition, elements, philosophies  <b>ICH Guidelines:</b> purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines  <b>Quality by design (QbD):</b> Definition, overview, elements of QbD program, tools  <b>ISO 9000 &amp; ISO14000:</b> Overview, Benefits, Elements, steps for registration  <b>NABL accreditation:</b> Principles and procedures</p>	22.22%	10
2	<p><b>UNIT – II</b>  <b>Organization and personnel:</b> Personnel responsibilities, training, hygiene and personal records.  <b>Premises:</b> Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.  <b>Equipments and raw materials:</b> Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.</p>	22.22%	10
3	<p><b>UNIT- III</b>  <b>Quality Control:</b> Quality control test for containers, rubber closures and secondary packing materials.  <b>Good Laboratory Practices:</b> 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</p>	22.22%	10
4	<p><b>UNIT- IV</b>  <b>Complaints:</b> Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.  <b>Document maintenance in pharmaceutical industry:</b> Batch Formula Record, Master Formula Record, SOP,</p>	17.77%	8

	Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.		
<b>5</b>	<b>UNIT – V</b> <b>Calibration and Validation:</b> 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. <b>Warehousing:</b> Good warehousing practice, materials management	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 IWHO 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 Dekker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

## Semester VII

- a. Course Name:** Instrumental Methods of Analysis  
**b. Course Code:** BP701T  
**c. Prerequisite:** Students should have the basic knowledge of instruments and analysis.  
**d. Rationale:** 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.  
**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
<b>CLOBJ 2</b>	Understand the chromatographic separation and analysis of drugs.
<b>CLOBJ 3</b>	Perform quantitative & qualitative analysis of drugs using various analytical instruments.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Summarize interaction of Electromagnetic radiation with matter, Spectroscopic technique including UV-Visible and Fluorimetry theory, Instrumentation and Application
<b>CLO 2</b>	Explain spectroscopic technique like IR, Flame photometry, atomic absorption and Nephelometry.
<b>CLO 3</b>	Understand chromatographic separation and analysis including TLC, Paper, Column chromatography and HPLC
<b>CLO 4</b>	Acquire knowledge of advanced chromatographic methods like Gas, ion exchange, affinity and gel chromatography theory, instrumentation and applications; Electrophoresis – theory and application
<b>CLO 5</b>	Carry out qualitative and quantitative analysis of drug using instrumental analytical techniques

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme		
L	T	P	C	Internal Evaluation	ESE	Total

				<b>MSE</b>	<b>CE</b>	<b>P</b>	<b>Theory</b>	<b>P</b>	
<b>4</b>	-	-	<b>4</b>	<b>15</b>	<b>10</b>	-	<b>75</b>	-	<b>100</b>
	-	<b>4</b>	<b>2</b>			<b>15</b>		<b>35</b>	<b>50</b>

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**j. Course Content:**

<b>Sr. No.</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<p><b>UNIT-I</b></p> <p><b>UV Visible spectroscopy</b> 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</p> <p><b>Fluorimetry</b> Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications</p>	<b>22.22%</b>	<b>10</b>
<b>2</b>	<p><b>UNIT-II</b></p> <p><b>IR spectroscopy</b> Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications <b>Flame Photometry</b>-Principle, interferences, instrumentation and applications <b>Atomic absorption spectroscopy</b> Principle, interferences, instrumentation and applications <b>Nepheloturbidometry</b>- Principle, instrumentation and applications</p>	<b>22.22%</b>	<b>10</b>
<b>3</b>	<p><b>UNIT-III</b></p> <p><b>Introduction to chromatography</b></p>	<b>22.22%</b>	<b>10</b>

	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		
<b>4</b>	<b>UNIT-IV</b> <b>Gas chromatography</b> Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications <b>High performance liquid chromatography (HPLC)</b> -Introduction, theory, instrumentation, advantages and applications	<b>17.77%</b>	<b>8</b>
<b>5</b>	<b>UNIT-V</b> <b>Ion exchange chromatography-</b> Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications <b>Gel chromatography</b> -Introduction, theory, instrumentation and applications <b>Affinity chromatography</b> -Introduction, theory, instrumentation and applications	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

#### **h. Text Book and Reference Book:**

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

**a. Course Name:** Industrial Pharmacy II

**b. Course Code:** BP702T

**c. Prerequisite:** Students should have the basic knowledge of pharmaceuticals.

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

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know the process of pilot plant and scale up of pharmaceutical dosage forms
<b>CLOBJ 2</b>	Understand the process of technology transfer from lab scale to commercial batch
<b>CLOBJ 3</b>	Know different Laws and Acts that regulate pharmaceutical industry
<b>CLOBJ 4</b>	Understand the approval process and regulatory requirements for drug products

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Learn the pilot plant scale up techniques for solids, semisolids, injectables dosage forms.
<b>CLO 2</b>	Understand the guidelines and techniques of technology transfer in Pharmaceutical Industry

<b>CLO 3</b>	Familiarize with the concepts of regulatory affair and comprehend the regulatory requirements and guidelines for drug development and drug approval process
<b>CLO 4</b>	Gain knowledge of the the concept of quality management systems, total quality management, QBD.
<b>CLO 5</b>	Understand the approval process and regulatory requirements for drug products

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p><b>Pilot plant scale up techniques:</b> 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.</p> <p><b>Pilot plant scale up techniques:</b> 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</p>	22.22%	10
2	<p><b>UNIT-II</b></p> <p><b>Technology development and transfer:</b> WHO guidelines for Technology Transfer(TT): Terminology, Technology</p>	22.22%	10

	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		
3	<p><b>UNIT-III</b></p> <p><b>Regulatory affairs:</b> Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals</p> <p><b>Regulatory requirements for drug approval:</b> 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</p>	22.22%	10
4	<p><b>UNIT-IV</b></p> <p><b>Quality management systems:</b> Quality management &amp; 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</p>	17.77%	8
5	<p><b>UNIT-V</b></p> <p>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.</p>	15.55%	7
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7<sup>th</sup> April available at [http://en.wikipedia.org/wiki/Regulatory\\_Affairs](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. Regulatory Affairs brought by learning plus, inc. available at <http://www.cgmp.com/ra.htm>.

**a. Course Name:** Pharmacy Practice

**b. Course Code:** BP703T

**c. Prerequisite:** Students should have the basic knowledge of anatomy physiology and pharmacology.

**d. Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know various drug distribution methods in a hospital
<b>CLOBJ 2</b>	Appreciate the pharmacy stores management and inventory control
<b>CLOBJ 3</b>	Monitor drug therapy of patient through medication chart review and clinical review
<b>CLOBJ 4</b>	Obtain medication history interview and counsel the patients

<b>CLOBJ 5</b>	Identify drug related problems
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the detailed aspects and elements of hospital organization, hospital Pharmacy, Adverse drug reaction and community pharmacy
<b>CLO 2</b>	Learn the concept of drug distribution system in hospital, Hospital formulary, therapeutic drug monitoring, medication adherence, patient medication history and community pharmacy management
<b>CLO 3</b>	Understand the organization and functions of pharmacy and therapeutics committee, drug information services, patient counselling, education and training
<b>CLO 4</b>	Recall the concepts of budget preparation and implementation in clinical Pharmacy
<b>CLO 5</b>	Remember the aspects of drug store management and inventory control

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p>a) <b>Hospital and it's organization</b> 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.</p> <p>b) <b>Hospital pharmacy and its organization</b> Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.</p> <p>c) <b>Adverse drug reaction</b> Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic</p>	22.22%	10

	<p>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.</p> <p>d) <b>Community Pharmacy</b></p> <p>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.</p>		
2	<p><b>UNIT-II</b></p> <p><b>a) Drug distribution system in a hospital</b> 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.</p> <p><b>b) Hospital formulary</b> Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.</p> <p><b>c) Therapeutic drug monitoring</b> Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.</p> <p><b>d) Medication adherence</b> Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.</p> <p><b>e) Patient medication history interview</b> Need for the patient medication history interview, medication interview forms.</p> <p><b>f) Community pharmacy management</b> Financial, materials, staff, and infrastructure requirements.</p>	22.22%	10
3	<p><b>UNIT-III</b></p> <p><b>a) Pharmacy and therapeutic committee</b> 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.</p> <p><b>b) Drug information services</b></p>	22.22%	10

	<p>Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.</p> <p><b>c) Patient counseling</b> Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist</p> <p><b>d) Education and training program in the hospital</b> 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.</p> <p><b>e) Prescribed medication order and communication skills</b> Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients</p>		
4	<p><b>UNIT-IV</b></p> <p><b>a) preparation and implementation:</b> Budget preparation and implementation</p> <p><b>b) Clinical Pharmacy:</b> 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 &amp; disease pattern.</p> <p><b>c) Over the counter (OTC) sales:</b> Introduction and sale of over the counter, and Rational use of common over the counter medications.</p>	17.77%	8
5	<p><b>UNIT-V</b></p> <p><b>Drug store management and inventory control:</b> 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</p> <p><b>Investigational use of drugs:</b> Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.</p> <p><b>Interpretation of Clinical Laboratory Tests:</b> Blood chemistry, hematology, and urinalysis</p>	15.55%	7
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Novel Drug Delivery Systems
- b. **Course Code:** BP704T
- c. **Prerequisite:** Students should have the basic knowledge of pharmaceuticals.
- d. **Rationale:** This subject is designed to impart basic knowledge on the area of novel drug delivery systems.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To understand various approaches for development of novel drug delivery systems.
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<b>CLOBJ 2</b>	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand various approaches for development of controlled drug delivery systems and the polymers used for the preparation.
<b>CLO 2</b>	Describe the various approaches for development of mucosal drug delivery, microencapsulation and implants
<b>CLO 3</b>	Gain the knowledge of various approaches for development of transdermal, nasal and GRDDS.
<b>CLO 4</b>	Know the various approaches for development of targeted delivery systems.
<b>CLO 5</b>	Study the Ocular and Intrauterine Drug Delivery Systems:

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**j. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b></p> <p><b>Controlled drug delivery systems:</b> 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.</p> <p><b>Polymers:</b> Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.</p>	22.22%	10
2	<p><b>UNIT-II</b></p> <p><b>Microencapsulation:</b> Definition, advantages and disadvantages, microspheres/microcapsules,</p>	22.22%	10

	<p>microparticles, methods of microencapsulation, applications.</p> <p><b>Mucosal Drug Delivery system:</b> Introduction, Principles of bioadhesion/ mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems</p> <p><b>Implantable Drug Delivery Systems:</b> Introduction, advantages and disadvantages, concept of implants and osmotic pump.</p>		
<b>3</b>	<p><b>UNIT-III</b></p> <p><b>Transdermal Drug Delivery Systems:</b> Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches.</p> <p><b>Gastroretentive drug delivery systems:</b> Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems, inflatable and gastroadhesive systems and their applications.</p> <p><b>Nasopulmonary drug delivery system:</b> Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT-IV</b></p> <p>Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications.</p>	<b>17.77%</b>	<b>8</b>
<b>5</b>	<p><b>UNIT-V</b></p> <p>Ocular Drug Delivery Systems: Introduction, intraocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts.</p> <p>Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications.</p>	<b>15.55%</b>	<b>7</b>
	<b>Total</b>	<b>100 %</b>	<b>45</b>

#### **h. Text Book and Reference Book:**

1. Y W. Chien, Novel Drug Delivery Systems, 2<sup>nd</sup> 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.

- a. Course Name:** Biostatistics and Research Methodology  
**b. Course Code:** BP801T  
**c. Prerequisite:** Students should have the basic knowledge of statics and pharmacology.  
**d. Rationale:** 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.  
**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
<b>CLOBJ 2</b>	Know the various statistical techniques to solve statistical problems
<b>CLOBJ 3</b>	Appreciate statistical techniques in solving the problems.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Recall the concept of health with health education, social education, sociology, and hygiene.
<b>CLO 2</b>	Considerate the concept of preventive medicine by exploring the principles of prevention and control of diseases.
<b>CLO 3</b>	Describe various national health program for its objectives, functioning and outcomes.
<b>CLO 4</b>	Explain the various targeted national interventional program for its objectives, functioning and outcomes.
<b>CLO 5</b>	Understand the role of community services in rural, urban and school health mission.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>Introduction:</b> Statistics, Biostatistics, Frequency distribution <b>Measures of central tendency:</b> Mean, Median, Mode-Pharmaceutical examples <b>Measures of dispersion:</b> Dispersion, Range, standard deviation, Pharmaceutical problems <b>Correlation:</b> Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	22.22%	10
2	<b>UNIT-II</b> <b>Regression:</b> 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 <b>Probability:</b> 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 <b>Parametric test:</b> t-test(Sample, Pooled or Unpaired)	22.22%	10
3	<b>UNIT-III</b> <b>Non-Parametric tests:</b> Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test <b>Introduction to Research:</b> Need for research, Need for design of Experiments, Experimental Design Technique, plagiarism <b>Graphs:</b> Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph <b>Designing the methodology:</b> 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.	22.22%	10
4	<b>UNIT-IV</b> Blocking and confounding system for Two-level factorials <b>Regression modeling:</b> Hypothesis testing in Simple and Multiple regression models <b>Introduction to Practical components of Industrial and Clinical Trials Problems:</b> Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS,	17.77%	08
5	<b>UNIT-V</b> <b>Design and Analysis of experiments:</b> <b>Factorial Design:</b> Definition, 2 <sup>2</sup> , 2 <sup>3</sup> design. Advantage of factorial design <b>Response Surface methodology:</b> Central composite design, Historical design, Optimization Techniques	15.55%	07
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. "Signals and Systems" by Alan V. Oppenheim and Alan S. Willsky.
2. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton,
3. publisher Marcel Dekker Inc. NewYork.
4. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
5. Design and Analysis of Experiments –PHI Learning Private Limited, R.
6. Pannerselvam,
7. Design and Analysis of Experiments – Wiley Students Edition,
8. Douglas and C. Montgomery

- a. **Course Name:** Social and Preventive Pharmacy
- b. **Course Code:** BP802T
- c. **Prerequisite:** Students should have the basic knowledge of health programmes health issues.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.\
<b>CLOBJ 2</b>	Have a critical way of thinking based on current healthcare development.
<b>CLOBJ 3</b>	Evaluate alternative ways of solving problems related to health and pharmaceutical issues

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the concept of health with health education, social education, sociology and hygiene.
<b>CLO 2</b>	Remember the concept of preventive medicine by exploring the principles of prevention and control of diseases.
<b>CLO 3</b>	Learn about various national health program for its objectives, functioning and outcomes.
<b>CLO 4</b>	Understand various targeted national interventional program for its objectives, functioning and outcomes.
<b>CLO5</b>	Remember the role of community services in rural, urban and school health mission.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Concept of health and disease:</b> 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.  <b>Social and health education:</b> Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.  <b>Sociology and health:</b> Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health  <b>Hygiene and health:</b> personal hygiene and health care; avoidable habits</p>	22.22%	10
2	<p><b>UNIT-II</b>  <b>Preventive medicine:</b> 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</p>	22.22%	10
3	<p><b>UNIT-III</b>  <b>National health programs, its objectives, functioning and outcome of the following:</b>  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.</p>	22.22%	10
4	<p><b>UNIT-IV</b>  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</p>	17.77%	08
5	<p><b>UNIT-V</b>  Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national</p>	15.55%	07

	urban health mission, Health promotion and education in school.		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 RoyRabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D,Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

**a. Course Name:** Pharma Marketing Management

**b. Course Code:** BP803ET

**c. Prerequisite:** Students should have the basic knowledge of pharmacology, chemistry and marketing

**d.** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.
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**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the concepts marketing in pharmaceutical market
<b>CLO 2</b>	Gain the knowledge of the product to be marketed and learn the Product management in pharmaceutical industry
<b>CLO 3</b>	Study the techniques to do the promotion
<b>CLO 4</b>	Learn the details of pharmaceutical marketing channels and know the duties of Professional sales representative (PSR)
<b>CLO 5</b>	Know the pricing methods for pharmaceutical products

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>  <b>Marketing:</b>            Definition, general concepts and scope of marketing; Distinction between marketing &amp; selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.</p> <p><b>Pharmaceutical market:</b>            Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation &amp; targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.</p>	22.22%	10
2	<p><b>UNIT-II</b>  <b>Product decision:</b>            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.</p>	22.22%	10
3	<p><b>UNIT-III</b>  <b>Promotion:</b>            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</p>	22.22%	10
4	<p><b>UNIT-IV</b>  <b>Pharmaceutical marketing channels:</b>            Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.</p> <p><b>Professional sales representative (PSR):</b>            Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.</p>	17.77%	08
5	<p><b>UNIT-V</b>  <b>Pricing:</b>            Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of</p>	15.55%	07

	DPCO (Drug Price Control Order)and NPPA (National Pharmaceutical Pricing Authority). <b>Emerging concepts in marketing:</b> Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing.		
	<b>Total</b>	<b>100%</b>	<b>45</b>

i. **Text Book and Reference Book:**

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, IndianContext, 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.

- a. **Course Name:** Pharmaceutical Regulatory Science
- b. **Course Code:** BP804ET
- c. **Prerequisite:** Students should have the basic knowledge of drugs and its legislation.
- d. 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know about the process of drug discovery and development
<b>CLOBJ 2</b>	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLOBJ 3</b>	Know the regulatory approval process and their registration in Indian and international markets

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the process of drug discovery and development
<b>CLO 2</b>	Explain the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
<b>CLO 3</b>	Identify the process of Registration of Indian drug product in overseas market

<b>CLO 4</b>	Explain the process to conduct Clinical trials
<b>CLO 5</b>	Recognize the key Regulatory Concepts.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> <b>New Drug Discovery and development</b> 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.	22.22%	10
2	<b>UNIT-II</b> <b>Regulatory Approval Process</b> 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. <b>Regulatory authorities and agencies</b> Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	22.22%	10
3	<b>UNIT-III</b> <b>Registration of Indian drug product in overseas market</b> Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic	22.22%	10

	Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research.		
<b>4</b>	<b>UNIT-IV Clinical trials</b> 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	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V Regulatory Concepts</b> Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.

- 1.
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
4. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
5. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene

a. **Course Name:** Pharmacovigilance

b. **Course Code:** BP805ET

c. **Prerequisite:** Students should have the basic knowledge of pharmacology and computer

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Why drug safety monitoring is important?
<b>CLOBJ 2</b>	History and development of pharmacovigilance
<b>CLOBJ 3</b>	National and international scenario of pharmacovigilance
<b>CLOBJ 4</b>	Dictionaries, coding and terminologies used in pharmacovigilance
<b>CLOBJ 5</b>	Detection of new adverse drug reactions and their assessment

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basics of pharmacovigilance and classify adverse drug reactions and their assessment
<b>CLO 2</b>	Remember the International standards for classification of diseases and drugs. List the Dictionaries, coding in pharmacovigilance and also learn to Establish pharmacovigilance programme and know the resources available
<b>CLO 3</b>	Explain about the Vaccine safety surveillance, Pharmacovigilance methods and Communication system in pharmacovigilance
<b>CLO 4</b>	Understand the Methods to generate safety data and know about the ICH guidelines pharmacovigilance
<b>CLO 5</b>	Demonstrate the Pharmacogenomics of ADR Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation. Study the CIOMS and CDSCO requirements for ADR reporting

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>Unit-I</b> <b>Introduction to Pharmacovigilance</b> History and development of Pharmacovigilance Importance of safety monitoring of Medicine WHO international drug monitoring programme Pharmacovigilance Program of India(PvPI) <b>Introduction to adverse drug reactions</b> 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 <b>Basic terminologies used in pharmacovigilance</b> Terminologies of adverse medication related events. Regulatory terminologies	22.22%	10
2	<b>Unit-II</b> <b>Drug and disease classification</b>	22.22%	10

	<p>Anatomical, therapeutic and chemical classification of drugs. International classification of diseases Daily defined doses. International Non proprietary Names for drugs</p> <p><b>Drug dictionaries and coding in pharmacovigilance</b> WHO adverse reaction terminologies. MedDRA and Standardised MedDRA queries. WHO drugs dictionary. Eudravigilance medicinal product dictionary</p> <p><b>Information resources in pharmacovigilance</b> Basic drug information resources. Specialised resources for ADRs</p> <p><b>Establishing pharmacovigilance programme</b> Establishing in a hospital. Establishment &amp; operation of drug safety department in industry. Contract Research Organisations (CROs) Establishing a national programme</p>		
<b>3</b>	<p><b>Unit-III</b> <b>Vaccine safety surveillance</b> Vaccine Pharmacovigilance. Vaccination failure Adverse events following immunization</p> <p><b>Pharmacovigilance methods</b> Passive surveillance – Spontaneous reports and case series Stimulated reporting. Active surveillance – Sentinel sites, drug event monitoring and registries. Comparative observational studies – Cross sectional study, case control study and cohort study Targeted clinical investigations</p> <p><b>Communication in pharmacovigilance</b> Effective communication in Pharmacovigilance. Communication in Drug Safety Crisis management. Communicating with Regulatory Agencies, Business Partners, Healthcare facilities &amp; Media</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>Unit-IV</b> <b>Safety data generation</b> Pre clinical phase Clinical phase Post approval phase (PMS)</p> <p><b>ICH Guidelines for Pharmacovigilance</b> 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</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>Unit-V</b> <b>Pharmacogenomics of adverse drug reactions</b> Genetics related ADR with example focusing PK parameters.</p> <p><b>Drug safety evaluation in special population</b> Paediatrics. Pregnancy and lactation. Geriatrics</p> <p><b>CIOMS: CIOMS Working Groups. CIOMS Form</b> <b>CDSCO (India) and Pharmacovigilance</b></p>	<b>15.55%</b>	<b>07</b>

	D&C Act and Schedule Y. Differences in Indian and global pharmacovigilance requirements		
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 Pharmacoepidemiology 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 Nyfort Hansen, Milap C. Nahata

**a. Course Name:** Quality Control and Standardization of Herbals

**b. Course Code:** BP806ET

**c. Prerequisite:** Students should have the basic knowledge of analysis of crude drugs and its regulatory requirements.

**d. Rationale:** 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.

**e. Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Learn the WHO guidelines for quality control of herbal drugs
<b>CLO 2</b>	Check out the Quality assurance in herbal drug industry
<b>CLO 3</b>	Consider the EU and ICH guidelines for quality control of herbal drugs
<b>CLO 4</b>	Know about the Stability testing of herbal medicines
<b>CLO 5</b>	Gain the knowledge about the Regulatory requirements for herbal medicines

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> 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	22.22%	10
2	<b>UNIT-II</b> <b>Quality assurance in herbal drug industry</b> 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.	22.22%	10
3	<b>UNIT-III</b> EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines.	22.22%	10

4	<b>UNIT-IV</b> 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.	17.77%	08
5	<b>UNIT-V</b> 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	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

- 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

a. **Course Name:** Computer Aided Drug Design

b. **Course Code:** BP807ET

c. **Prerequisite:** Students should have the basic knowledge of organic, medicinal chemistry and computer application.

**d. Rationale:** 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.

**e. Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand stages of drug discovery and development
<b>CLO 2</b>	Understand the concept of QSAR
<b>CLO 3</b>	Learn the Molecular Modelling and virtual screening techniques
<b>CLO 4</b>	Introduction to bioinformatics & Methods in drug design
<b>CLO 5</b>	Learn to Design of new drug molecules using molecular modelling software

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>Unit-I</b> <b>Introduction to Drug Discovery and Development</b> Stages of drug discovery and development <b>Lead discovery and Analog Based Drug Design</b> 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. <b>Analog Based Drug Design:</b> Bioisosterism, Classification, Bioisosteric replacement. Any three case studies	22.22%	10
2	<b>Unit-II</b> <b>Quantitative Structure Activity Relationship (QSAR)</b> SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.	22.22%	10
3	<b>Unit-III</b> <b>Molecular Modeling and virtual screening techniques</b> <b>Virtual Screening techniques:</b> Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, <b>Molecular docking:</b> Rigid docking, flexible docking, manual docking, Docking based screening. <i>De novo</i> drug design.	22.22%	10
4	<b>Unit-IV</b> <b>Informatics &amp; Methods in drug design</b> Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	17.77%	08
5	<b>Unit-V</b> <b>Molecular Modeling:</b> Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.	15.55%	07
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park 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.

- a. **Course Name:** Cell and Molecular Biology
- b. **Course Code:** BP808ET
- c. **Prerequisite:** Students should have the basic knowledge of anatomy and biology.
- d. **Rationale:** 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 organisms such as humans, plants, and sponges.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Summarize cell and molecular biology history.
<b>CLOBJ 2</b>	Summarize cellular functioning and composition.
<b>CLOBJ 3</b>	Describe the chemical foundations of cell biology.
<b>CLOBJ 4</b>	Summarize the DNA properties of cell biology.
<b>CLOBJ 5</b>	Describe protein structure and function.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Summarize the basics of cell and molecular biology, Prokaryotic Eukaryotic, their properties Reproduction and Chemical Foundations
<b>CLO 2</b>	Learn the DNA and RNA of cell
<b>CLO 3</b>	Know about the details of protein and its synthesis
<b>CLO 4</b>	Understand the basic molecular genetic mechanisms.
<b>CLO 5</b>	Study the cell signals

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

<b>Sr. No.</b>	<b>Content</b>	<b>Weightage</b>	<b>Teaching Hours</b>
<b>1</b>	<b>Unit-I</b> 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)	<b>22.22%</b>	<b>10</b>
<b>2</b>	<b>Unit-II</b> a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>Unit-III</b> a) Proteins: Defined <b>and</b> Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>Unit-IV</b> a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>Unit-V</b> a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

1. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
2. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.

3. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
4. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
5. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
6. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
7. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
8. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.

a. **Course Name:** Cosmetic Science

b. **Course Code:** BP809ET

c. **Prerequisite:** Students should have the basic knowledge of pharmaceutics.

d. **Rationale:** This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Key ingredients used in cosmetics and cosmeceuticals.
<b>CLOBJ 2</b>	Key building blocks for various formulations
<b>CLOBJ 3</b>	Current technologies in the market
<b>CLOBJ 4</b>	Various key ingredients and basic science to develop cosmetics and cosmeceuticals
<b>CLOBJ 5</b>	Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Know and explain about cosmetics, and related sciences, cosmeceuticals (cosmetics with skin, hair and oral care benefits) and personal care and hygiene products.
<b>CLO 2</b>	Principles of formulation and building blocks of skin and hair care products
<b>CLO 3</b>	Study the Role of herbs in cosmetics and know about the Analytical cosmetics
<b>CLO 4</b>	Study the Principles of Cosmetic Evaluation
<b>CLO 5</b>	Describe about basic cosmetic problems associated with skin, hair and oral care etc.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-I</b>            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  <b>Cosmetic excipients:</b> Surfactants, rheologymodifiers, humectants, emollients, preservatives. Classification and application  <b>Skin:</b> Basic structure and function of skin.  <b>Hair:</b> Basic structure of hair. Hair growth cycle.  <b>Oral Cavity:</b> Common problem associated with teeth and gums.</p>	22.22%	10
2	<p><b>UNIT-II</b>  <b>Principles of formulation and building blocks of skin care products:</b>            Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.  <b>Antipersants &amp; deodorants-</b> Actives &amp; mechanism of action.  <b>Principles of formulation and building blocks of Hair care products:</b>            Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phenylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.</p>	22.22%	10
3	<p><b>UNIT-III</b>            Sun protection, Classification of Sunscreens and SPF.  <b>Role of herbs in cosmetics:</b>            Skin Care: Aloe and turmeric            Hair care: Henna and amla.            Oral care: Neem and clove</p>	22.22%	10

	<b>Analytical cosmetics:</b> BIS specification and analytical methods for shampoo, skincream and toothpaste.		
<b>4</b>	<b>UNIT- IV</b> Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V</b> 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 cause Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Experimental Pharmacology
- b. **Course Code:** BP810ET
- c. **Prerequisite:** Students should have the basic knowledge of pharmacology.
- d. **Rationale:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Appreciate the applications of various commonly used laboratory animals.
<b>CLOBJ 2</b>	Appreciate and demonstrate the various screening methods used in preclinical research
<b>CLOBJ 3</b>	Appreciate and demonstrate the importance of biostatistics and research methodology
<b>CLOBJ 4</b>	Design and execute a research hypothesis independently

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Appreciate the applications of various commonly used laboratory animals
<b>CLO 2</b>	Study the preclinical studies and screening models for drugs acting on ANS
<b>CLO 3</b>	Demonstrate the various screening methods used in preclinical research for drugs acting on CNS
<b>CLO 4</b>	Demonstrate the various screening methods used in preclinical research for drugs acting on CVS
<b>CLO 5</b>	Recognize the importance of biostatistics and research methodology

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<p><b>UNIT-1</b>  <b>Laboratory Animals:</b>                      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.</p>	22.22%	10
2	<p><b>UNIT -II</b>  <b>Preclinical screening models</b>                      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. <b>Study of screening animal models for</b>                      Diuretics, nootropics, anti-Parkinson's, antiasthmatics,  <b>Preclinical screening models:</b> for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease</p>	22.22%	10
3	<p><b>UNIT -III</b>  <b>Preclinical screening models:</b> for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics</p>	22.22%	10

4	<b>UNIT -IV</b> <b>Preclinical screening models:</b> for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, antiaggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	17.77%	08
5	<b>UNIT-V</b> <b>Research methodology and Bio-statistics</b> 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	15.55%	07
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 Rao and J Richard

- a. **Course Name:** Advanced Instrumentation Techniques
- b. **Course Code:** BP811ET
- c. **Prerequisite:** Students should have the basic knowledge of analysis and instruments.
- d. **Rationale:** This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the advanced instruments used and its applications in drug analysis
<b>CLOBJ 2</b>	Understand the chromatographic separation and analysis of drugs.
<b>CLOBJ 3</b>	Understand the calibration of various analytical instruments
<b>CLOBJ 4</b>	Know analysis of drugs using various analytical instruments.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Learn the fundamentals of advanced analytical techniques like Nuclear Magnetic Resonance spectroscopy and Mass Spectrometry and the related instruments
<b>CLO 2</b>	Understand the fundamentals of advanced analytical techniques like Thermal Methods of Analysis and Mass Spectrometry
<b>CLO 3</b>	Summarize the calibration and validation of various analytical instruments
<b>CLO 4</b>	Gain knowledge about the importance, principle application of Radio immune assay and Extraction techniques
<b>CLO 5</b>	Study the details of Hyphenated techniques

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-1</b> <b>Nuclear Magnetic Resonance spectroscopy</b> Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications <b>Mass Spectrometry-</b> Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	22.22%	10
2	<b>UNIT -II</b> <b>Thermal Methods of Analysis:</b> Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) <b>X-Ray Diffraction Methods:</b> Origin of X-rays, basic aspects of crystals, Xray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.	22.22%	10
3	<b>UNIT -III</b> <b>Calibration and validation-</b> as per ICH and USFDA guidelines <b>Calibration of following Instruments</b>	22.22%	10

	Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC		
4	<b>UNIT-IV</b> <b>Radio immune assay:</b> Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay <b>Extraction techniques:</b> General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	17.77%	08
5	<b>UNIT-V</b> <b>Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.</b>	15.55%	07

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Dietary Supplements and Nutraceuticals
- b. **Course Code:** BP812ET
- c. **Prerequisite:** Students should have the basic knowledge of pharmacology and chemistry.
- d. **Rationale:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.
- e. **Course Learning Objective:**

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

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Outline the need of dietary supplements and Nutraceuticals to maintain healthy life.
<b>CLO 2</b>	Find about the Occurrence and characteristic features of Phytochemicals as nutraceuticals
<b>CLO 3</b>	Demonstrate the free radicals and Dietary fibres
<b>CLO 4</b>	Understand the outcome of deficiencies in dietary supplements
<b>CLO 5</b>	Appreciate the regulatory and commercial aspects of dietary supplements including health claims

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	<b>UNIT-I</b> 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,	22.22%	10

	Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds		
<b>2</b>	<p><b>UNIT-II</b>  Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following</p> <p>a) Carotenoids- <math>\alpha</math> and <math>\beta</math>-Carotene, Lycopene, Xanthophylls, leutin</p> <p>b) Sulfides: Diallyl sulfides, Allyl trisulfide.</p> <p>c) Polyphenolics: Reservetrol</p> <p>d) Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones</p> <p>e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum</p> <p>f) Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans</p> <p>g) Tocopherols</p> <p>h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.</p>	<b>22.22%</b>	<b>10</b>
<b>3</b>	<p><b>UNIT-III</b>  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.</p> <p>b) Dietary fibres and complex carbohydrates as functional food ingredients.</p>	<b>22.22%</b>	<b>10</b>
<b>4</b>	<p><b>UNIT-IV</b>  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.</p> <p>b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, <math>\alpha</math>- Lipoic acid, melatonin. Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.</p> <p>c) Functional foods for chronic disease prevention</p>	<b>17.77%</b>	<b>08</b>
<b>5</b>	<p><b>UNIT-V</b>  a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.</p> <p>b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.</p> <p>c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.</p>	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100%</b>	<b>45</b>

**i. Text Book and Reference Book:**

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

- a. **Course Name:** Pharmaceutical Product Development  
 b. **Course Code:** BP813ET  
 c. **Prerequisite:**  
 d. **Rationale:** This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.  
 e. **Course Learning Objective:**

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

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basic concepts of Preformulation, stability, manufacturing and quality control in pharmaceutical product development
<b>CLO 2</b>	Study the excipients used in liquid and semisolid pharmaceutical product development
<b>CLO 3</b>	Study the excipients used in solid, parenteral and novel pharmaceutical product development
<b>CLO 4</b>	Study various optimization techniques in pharmaceutical product development
<b>CLO 5</b>	Study and quality control testing of packaging material.

- g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	15	10	-	75	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

- h. **Course Content:**

Sr. No.	Content	Weightage	Teaching Hours
1	UNIT-I	22.22%	10

	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		
<b>2</b>	<b>UNIT-II</b> 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	<b>22.22%</b>	<b>10</b>
<b>3</b>	<b>UNIT-III</b> 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	<b>22.22%</b>	<b>10</b>
<b>4</b>	<b>UNIT-IV</b> 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.	<b>17.77%</b>	<b>08</b>
<b>5</b>	<b>UNIT-V</b> Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	<b>15.55%</b>	<b>07</b>
	<b>Total</b>	<b>100 %</b>	<b>45</b>

**i. Text Book and Reference Book:**

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 and Leon 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 and Joseph 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 And H.A. Libermann.
13. Advanced Review Articles related to the topics.

## ANNEXURE-IV

### **Semester 1**

- a. **Course Name:** Human Anatomy and Physiology I Lab
- b. **Course Code:** BP107P
- c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.
- d. **Rationale:** 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.

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the various experiments related to special senses and nervous system.
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Recall and understand the anatomy and physiology of Human body and know the cellular and tissue level organization
<b>CLO 2</b>	Compare and study the anatomy and physiology of skin, skeletal system and joints.
<b>CLO 3</b>	Explain the role and functioning of blood and lymphatic system
<b>CLO 4</b>	Compare and contrast the anatomy and physiology of organs of the cardio vascular system, special senses and peripheral nervous system.
<b>CLO 5</b>	Demonstrate the ability to perform experiments on living issue and normal human beings and also perform the Hematological tests.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

- Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
- Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

3. Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, River view, 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.

**Reference Books (Latest Editions)**

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

**i. . Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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.
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- a. **Course Name:** Pharmaceutical Analysis I Lab  
b. **Course Code:** BP108P  
c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry  
d. **Rationale:** This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.  
e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the principles of volumetric and electro chemical analysis
<b>CLOBJ 2</b>	Carryout various volumetric and electrochemical titrations.
<b>CLOBJ 3</b>	Develop analytical skills

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand analytical techniques, concentration expression methods, and standards differentiation and preparation and standardization of various solutions, To study the overall concept of errors including methods of minimizing errors. Overview of Pharmacopoeia, Impurities and Limit Tests.
<b>CLO 2</b>	Illustrate the principles of Volumetric analysis by performing acid-base titrations, non-aqueous titrations.
<b>CLO 3</b>	Understand of Precipitation Titrations complexometric titrations, Gravimetry and Diazotisation Titration.
<b>CLO 4</b>	Explain Redox titrations and Electrochemical methods.
<b>CLO 5</b>	Develop the analytical skill by performing limit tests and titrations and doing the experiments on preparation, standardization, Assay of certain compounds.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	

	-	4	2			15		35	50
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L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Text Book and Reference Book:

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

#### i. Mapping of Experiment List with Course Learning Outcomes:

Sr. No.	Experiment List
1	To perform the limit test of Chloride
2	To perform the limit test of Sulphate
3	To perform the limit test of Iron
4	To perform the limit test of Arsenic
5	To prepare and standardize Sodium hydroxide
6	To prepare and standardize Sulphuric acid
7	To prepare and standardize Sodium thiosulfate
8	To prepare and standardize Potassium permanganate
9	To prepare and standardize Ceric ammonium sulphate
10	To perform the assay of Ammonium chloride by acid base titration
11	To perform the assay of Ferrous sulphate by Cerimetry
12	To perform the assay of copper sulphate by Iodometry
13	To perform the assay of Calcium gluconate by complexometry
14	To perform the assay of Hydrogen peroxide by Permanganometry
15	To perform the assay of Sodium benzoate by non-aqueous titration
16	To perform the assay of Sodium Chloride by precipitation titration
17	To determine the Normality by Conductometric titration of strong acid against strong base

18	To determine the normality by Conductometric titration of strong acid and weak acid against strong base
19	To determine the normality by Potentiometric titration of strong acid against strong base

- a. **Course Name:** Pharmaceutics-I Lab
- b. **Course Code:** BP109P
- c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.
- d. **Rationale:** This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the history of profession of pharmacy
<b>CLOBJ 2</b>	Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
<b>CLOBJ 3</b>	Understand the professional way of handling the prescription
<b>CLOBJ 4</b>	Preparation of various conventional dosage forms

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Comprehend the history of the pharmacy profession, Introduction to Dosage form prescription handling and explain posology
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<b>CLO 2</b>	Compare and contrast different dosage forms like powders, Liquid dosage forms and pharmaceutical calculations
<b>CLO 3</b>	Demonstrate an understanding of monophasic liquid dosage forms Biphasic liquid dosage forms and pharmaceutical Incompatibilities
<b>CLO 4</b>	Illustrate semisolid dosage forms and suppositories including displacement value calculation
<b>CLO 5</b>	Perform the preparation of various conventional dosage forms

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams andWalkins, New Delhi.
2. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan
3. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.
5. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA
6. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.
7. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.

8. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.
9. British pharmacopoeia.
10. Indian pharmacopoeia.
11. M.E. Aulton, Pharmaceutics, The Science & Dosage Form Design, Churchill Livingstone, Edinburgh.
12. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Introduction to weight and measures
2	To prepare and dispense simple syrup IP'66.
3	To prepare and dispense compound syrup of ferrous phosphate BPC'68.
4	To prepare and dispense paracetamol pediatric elixir.
5	To prepare and dispense Iodine throat paint (Mandles paint)
6	To prepare and dispense cresol with soap solution.
7	To prepare and dispense strong ammonium acetate solution.
8	To prepare and dispense calamine lotion.
9	To prepare and dispense turpentine liniment.
10	To prepare and dispense liquid paraffin emulsion.
11	To prepare and dispense effervescent granules.
12	To prepare and dispense dusting powder.
13	To prepare and dispense glycerol gelatin suppository.
14	To prepare and dispense sulphur ointment
15	To prepare and dispense Carbopol gel.
16	To prepare and dispense Iodine gargle.

17	To prepare and dispense cocoa butter suppository.
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- a. **Course Name: Pharmaceutical Inorganic Chemistry Lab**  
 b. **Course Code: BP110P**  
 c. **Prerequisite:** Students should have a background of Biology, Physics, and chemistry.  
 d. **Rationale:** This subject deals with the monographs of inorganic drugs and pharmaceuticals.  
 e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
<b>CLOBJ 2</b>	Understand the medicinal and pharmaceutical importance of inorganic compounds

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the sources of impurities in inorganic Drugs and pharmaceuticals and testing of impurities.
<b>CLO 2</b>	Learn about medicinal and pharmaceutical Importance of acids, bases, buffers, electrolytes and dental products.
<b>CLO 3</b>	Understand the medicinal and pharmaceutical uses of gastrointestinal agents and antimicrobials
<b>CLO 4</b>	Study the inorganic miscellaneous compounds and radiopharmaceuticals.
<b>CLO 5</b>	Demonstrate and explain the practicals on limit tests, identification test, test for purity and preparation of pharmaceutical inorganic compounds.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### **h. Text Book and Reference Book:**

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

#### **i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	C) To perform the limit test for Chlorides. D) To perform the limit test for Sulphate.
2	To perform the modified limit test for Chlorides and Sulphate.
3	C) To perform the limit test for Iron. D) To perform the limit test for Heavy metals.
4	To perform the limit test for Lead.
5	To perform the limit test for Arsenic.
6	To perform the Identification test for Magnesium Hydroxide.
7	To perform the Identification test for Ferrous Sulphate.
8	To perform the Identification test for Sodium Bicarbonate.
9	To perform the Identification test for Calcium Gluconate.
10	To perform the Identification test for Copper sulphate.
11	To test the Swelling power of Bentonite.
12	To test the Neutralizing capacity of Aluminum hydroxide gel.

13	To carry out the preparation of Boric acid.
14	To carry out the preparation of Potash Alum.
15	To carry out the preparation of the Ferrous Sulphate.

- a. **Course Name: Communication skills Lab**
- b. **Course Code: BP111P**
- c. **Prerequisite:** Students should have effective speaking and writing ability and self-awareness.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the behavioral needs for a pharmacist to function effectively in the areas of pharmaceutical operation
<b>CLOBJ 2</b>	Communicate effectively (Verbal and Non Verbal)

<b>CLOBJ 3</b>	Effectively manage the team as a team player
<b>CLOBJ 4</b>	Develop interview skills
<b>CLOBJ 5</b>	Develop Leadership qualities and essentials

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basics of Communication skills, the barriers and its perspectives.
<b>CLO 2</b>	Know about the communication style and Acquire the knowledge about the elements of communication
<b>CLO 3</b>	Learn the basic Listening and writing Skills
<b>CLO 4</b>	Develop the skills of facing interview, giving presentation and group discussion
<b>CLO 5</b>	Learn the practical aspects of communication skill to develop interview facing ability and leadership qualities.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	2	1			10		15	25

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011

5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala
6. Swamy Ramesh, 5thEdition, Pearson, 2013
7. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green
8. hall, 1st Edition Universe of Learning LTD, 2010
9. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals PHI, 2011
10. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
11. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
12. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To familiar students with different styles of communication skills
2	Understand and practice Interview etiquettes
3	To make students confident of speaking in English
4	To make the students understand the correct way of pronunciation
5	To encourage the students to improve their public speaking
6	To make students become more self-confident and develop strong determination
7	To learn how to overcome the barriers of communication
8	Students learn different techniques of presentation
9	To enhance practical learning to speak by the way of communication starter
10	To encourage the students to cultivate the capacity to accept challenges and manage the impact of adversity
11	To support the students to deliver their presentation that create maximum impact
12	To make the students understand 7cs of communication
13	Students learn different ways & tips for improving interview skills – mock interview
14	To guide students to improve writing skills

15	Learn to communicate and give presentation at a gathering, a broadly applicable professional skill.
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- a. **Course Name:** Remedial Biology Lab
- b. **Course Code:** BP112RBP
- c. **Prerequisite:** Students who have opted for Mathematics at their Higher secondary examination
- d. **Rationale:** To learn and understand the components of living world, structure and functional system of plant and animal kingdom.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the classification and salient features of five kingdoms of life
<b>CLOBJ 2</b>	Understand the basic components of anatomy & physiology of plant
<b>CLOBJ 3</b>	Know understand the basic components of anatomy & physiology animal with special reference to human

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand and classify living world and morphology of flowering plants
<b>CLO 2</b>	Study of body fluids, their circulation and understanding of functioning of respiratory system
<b>CLO 3</b>	Recall of the anatomy and physiology of human excretory system, nervous system, reproductive system and endocrine glands.
<b>CLO 4</b>	Demonstrate the anatomy & physiology of plants
<b>CLO 5</b>	Identification of plant parts and bones and to learn methods of blood group, blood pressure and tidal volume measurement

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	

	-	2	1			10		15	25
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**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Text Book and Reference Book:**

1. Text book of Biology by S. B. Gokhale
2. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram

**Reference Books**

1. A Text book of Biology by B.V. Sreenivasa Naidu
2. A Text book of Biology by Naidu and Murthy
3. Botany for Degree students By A.C.Dutta.
4. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
5. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	Introduction to experiments in biology (a) Study of Microscope (b) Section cutting techniques
2	Introduction to experiments in biology (c) Mounting and staining (d) Permanent slide preparation
3	Study of cell and its inclusions
4	Study of Stem, Root, Leaf and their modifications
5	Study of seed, fruit, flower and their modifications
6	Microscopic study and identification of tissues pertinent to Stem
7	Microscopic study and identification of tissues pertinent to Root
8	Microscopic study and identification of tissues pertinent to Leaf
9	Microscopic study and identification of tissues pertinent to Seed
10	Microscopic study and identification of tissues pertinent to fruit and flower

11	Identification of bones
12	Determination of blood group
13	Determination of blood pressure
14	Determination of tidal volume
15	Detailed study of frog by using computer models

## Semester 2

- a. **Course Name: Human Anatomy and Physiology II Lab**
- b. **Course Code: BP207P**
- c. **Prerequisite:** Students who have background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Explain the gross morphology, structure and functions of various organs of the human body.
<b>CLOBJ 2</b>	Describe the various homeostatic mechanisms and their imbalances.
<b>CLOBJ 3</b>	Identify the various tissues and organs of different systems of human body.
<b>CLOBJ 4</b>	Perform the hematological tests like blood cell counts, hemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume
<b>CLOBJ 5</b>	Appreciate coordinated working pattern of different organs of each system

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain the anatomy and physiology of nervous system and describe the digestive system
<b>CLO 2</b>	Describe the anatomy and physiology of respiratory system and energetics
<b>CLO 3</b>	Understand the anatomy and physiology of endocrine system and urinary system
<b>CLO 4</b>	Understand the anatomy and physiology of reproductive system and study of genetics
<b>CLO 5</b>	Demonstrate anatomy and physiology of various organs with the help of models and charts as well as practical understanding of their functions

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

1. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
2. Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co,Riverview,MI USA 56

3. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
4. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
5. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
6. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
7. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To study the integumentary system 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	To Study the histology of vital organs and gonads with the help of permanent slides.

- a. **Course Name:** Pharmaceutical Organic Chemistry-II Lab
- b. **Course Code:** BP208P
- c. **Prerequisite:** Students should have background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Write the structure, name and the type of isomerism of the organic compound
<b>CLOBJ 2</b>	Write the reaction, name the reaction and orientation of reactions
<b>CLOBJ 3</b>	Account for reactivity/stability of compounds,
<b>CLOBJ 4</b>	Identify /confirm the identification of organic compound

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain and classify organic compounds, nomenclature, and structural isomerism of organic compounds, carboxylic acids.
<b>CLO 2</b>	Study of Alkanes, Alkenes and Conjugated Dienes
<b>CLO 3</b>	Explain the Alkyl halides and alcohols, Explain and classify organic compounds
<b>CLO 4</b>	Study of carbonyl compounds, and Aliphatic Amines with reactions.
<b>CLO 5</b>	Identify unknown organic compound Understand qualitative analysis of unknown organic compounds, preparation of solid derivatives, and construction of molecular models

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Text Book and Reference Book:**

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.

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	To synthesize m-dinitrobenzene from nitrobenzene.
2	To synthesize acetanilide from aniline.
3	To synthesize p-iodo benzoic acid from benzoic acid.
4	To synthesize benzil from benzoin.
5	To synthesize dibenzal acetone from benzaldehyde (claisen-schamiat reaction).
6	To study about the recrystallization technique for purification of organic compounds.
7	To study about the steam distillation for purification of organic compounds.
8	To determine saponification value of given oil/fat sample.
9	To determine acid value of given oil/fat sample.
10	To determine iodine value of given oil/fat sample.

11	To synthesize benzoic acid from benzyl chloride.
12	To synthesize 1-phenyl 2-azo naphthol from aniline (coupling reaction).
13	To synthesize cinnamic acid from benzaldehyde (Perkin reaction).
14	To synthesize nitro benzene from benzene.
15	To synthesize methyl salicylate from salicylic acid.

- a. **Course Name:** Biochemistry Lab
- b. **Course Code:** BP209P
- c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the catalytic role of enzymes, importance of enzyme inhibitors in
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	design of new drugs, therapeutic and diagnostic applications of enzymes
<b>CLOBJ 2</b>	Understand the metabolism of nutrient molecules in physiological and pathological conditions.
<b>CLOBJ 3</b>	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study of biomolecules, bioenergetics and detailed study on enzymes
<b>CLO 2</b>	Understand the biological oxidation and study the metabolism of carbohydrates in physiological and pathological conditions
<b>CLO 3</b>	Explain the metabolism of nutrient molecules like lipids and amino acids in physiological and pathological conditions.
<b>CLO 4</b>	Study of Nucleic acid metabolism and genetic information transfer, the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins
<b>CLO 5</b>	Perform the qualitative and quantitative analysis of biomolecules, factors affecting on enzymes activity, preparation of buffer solution.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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.

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	Qualitative Analysis of Carbohydrates (Glucose, Fructose)
2	Qualitative Analysis of Carbohydrates (Lactose, Maltose)
3	Qualitative Analysis of Carbohydrates (Sucrose and Starch)
4	Identification tests for Proteins (Albumin and Casein)
5	Quantitative analysis of reducing Sugars (DNSA method) and Protein (biuret Method)
6	Qualitative analysis of Urine for abnormal Constituents
7	Determination of Blood Creatinine
8	Determination of Blood Sugar
9	Determination of serum total cholesterol
10	Preparation of buffer solution and measurement of pH
11	Study of Enzymatic hydrolysis of Starch
12	Determination of Salivary amylase activity
13	Study the effect of temperature on salivary amylase activity
14	Study the effect of substrate concentration on salivary amylase activity

- a. **Course Name:** Computer Applications in Pharmacy Lab
- b. **Course Code:** BP210P
- c. **Prerequisite:** Students should have a basic understanding of Computers.
- d. **Rationale:** This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various types of application of computers in pharmacy
<b>CLOBJ 2</b>	Know the various types of databases
<b>CLOBJ 3</b>	Know the various applications of databases in pharmacy

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the number system and know the concept of software and information system
<b>CLO 2</b>	Understand the importance of web technologies and programming languages
<b>CLO 3</b>	Learn the applications of computers in pharmacy
<b>CLO 4</b>	Learn Computers as data analysis in Preclinical development and understand the concept of bioinformatics
<b>CLO 5</b>	Performance of experiments to understand the practical applicability of computer in pharmacy

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	2	1			10		15	25

**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Text Book and Reference Book:**

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

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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 Design a form in MS Access to view, add, delete and modify the patient record int he 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

### Semester 3

- a. **Course Name:** Pharmaceutical Organic Chemistry –II Lab
- b. **Course Code:** BP305P
- c. **Prerequisite:** Students should have a background in Biology and Chemistry.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the structure, name and the type of isomerism of the organic compound.
<b>CLOBJ 2</b>	Know the reaction, name the reaction and orientation of reactions.
<b>CLOBJ 3</b>	Understand the account for reactivity/stability of compounds.

<b>CLOBJ 4</b>	Understand the preparation of Organic Compound
<b>CLOBJ 5</b>	Understand the Laboratory Techniques/Oil values/Preparation of Organic Compound.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Study the concept of aromaticity, structure, Reactions and synthesis of Benzene and its derivatives.
<b>CLO 2</b>	Describe the reactions and synthesis of Phenols, aromatic amines and aromatic acids.
<b>CLO 3</b>	Explain the fats and oils, reactivity and their quality control evaluation methods.
<b>CLO 4</b>	Study of stability and reactions of cycloalkanes, polynuclear hydrocarbons.
<b>CLO 5</b>	Synthesize various aromatic organic compounds and derivatives, determine oil values

**g. Mapping of Course Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To synthesize m-dinitrobenzene from nitrobenzene.
2	To synthesize acetanilide from aniline.
3	To synthesize p-iodo benzoic acid from benzoic acid.
4	To synthesize benzil from benzoin.
5	To synthesize dibenzal acetone from benzaldehyde (claisen-schamiat reaction).
6	To study about the recrystallization technique for purification of organic compounds.
7	To study about the steam distillation for purification of organic compounds.
8	To determine saponification value of given oil/fat sample.
9	To determine acid value of given oil/fat sample.
10	To determine iodine value of given oil/fat sample.
11	To synthesize benzoic acid from benzyl chloride.
12	To synthesize 1-phenyl 2-azo naphthol from aniline (coupling reaction).
13	To synthesize cinnamic acid from benzaldehyde (Perkin reaction).
14	To synthesize nitro benzene from benzene.
15	To synthesize methyl salicylate from salicylic acid.

a. **Course Name:** Physical Pharmaceutics-I Lab

b. **Course Code:** BP306P

c. **Prerequisite:** Students should have a background of Biology, Physics, and Chemistry.

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the designing the dosage forms.
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.
<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	Understand the various Pharmaceuticals Equation and formula and application of the same to derive the effective results.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand the solubility aspects of the drugs and various principles involved in it.
<b>CLO 2</b>	Explain the different states of matter and understand the basic principles of various physicochemical properties of drug molecules.
<b>CLO 3</b>	Demonstrate the Surface and interfacial phenomenon of liquid formulations and its importance in designing the dosage forms.
<b>CLO 4</b>	Understand the application of complexation and protein binding and study the concept of pH, buffers, isotonic solutions in pharmacy.
<b>CLO 5</b>	Demonstrate the use of physicochemical properties of drug in the formulation development and evaluation of dosage forms.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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.
5. Physical Pharmaceutics by Ramasamy C and Manavalan R.
6. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
7. Physical Pharmaceutics by C.V.S. Subramanyam
8. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar
9. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Determination the solubility of benzoic acid at room temperature.
2	Determination the solubility of NaCl at room temperature.
3	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
4	Determination of Partition co- efficient of benzoic acid in benzene and water.
5	Determination of Partition co- efficient of Iodine in CCl <sub>4</sub> and water.
6	Determination of Critical Solution temperature of phenol-water system.
7	Determination of % composition of NaCl in a solution using phenol-water system by CST method.
8	Determination of surface tension of given solution by drop count method.

9	Determination of surface tension of given solution by drop weight method.
10	Determination of HLB number of a surfactant by saponification method.
11	Determination of Freundlich and Langmuir constants using activated char coal.
12	Determination of critical micellar concentration of surfactant (SLS).
13	Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method.
14	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method.
15	Determination of Solubility-Co-Solvency effect

- a. **Course Name:** Pharmaceutical Microbiology Lab
- b. **Course Code:** BP307P
- c. **Prerequisite:**
- d. **Rationale:** Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand methods of identification, cultivation and preservation of various microorganisms
<b>CLOBJ 2</b>	To understand the importance and implementation of sterilization in pharmaceutical processing and industry
<b>CLOBJ 3</b>	Learn sterility testing of pharmaceutical products.
<b>CLOBJ 4</b>	Carried out microbiological standardization of Pharmaceuticals.
<b>CLOBJ 5</b>	Understand the cell culture technology and its applications in pharmaceutical industries.

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand various aspects of microorganisms, their growth and use of microscopes
<b>CLO 2</b>	Understand the various staining techniques to identify the microorganisms and also study the aspects of sterilization
<b>CLO 3</b>	Learn about the Fungi and Viruses along and summarize the disinfection techniques and sterility testing
<b>CLO 4</b>	Planning an aseptic area, study of spoilage and execute the microbiological standardization of Pharmaceuticals
<b>CLO 5</b>	Carry out the practicals to understand the characteristics of microorganisms and assessing antibiotics using aseptic techniques.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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. Pepler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions.
9. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
10. Edward: Fundamentals of Microbiology.
11. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
12. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
13. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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	Nutrient stabs and slants preparations and Sub culturing of bacteria on nutrient agar slant & stab.
3	Sub culturing of fungus on Sabouraud dextrose agar slant.
4	Study of bacterial morphology by Simple staining method
5	Study of bacterial morphology by Simple negative staining method
6	Study of bacterial morphology by Gram's staining method
7	Study of bacterial morphology by Acid fast staining method
8	Isolation of pure culture of micro-organisms by multiple streak plate technique
9	Microbiological assay of antibiotics by cup plate method.
10	Motility determination by Hanging drop method.
11	Sterility testing of Sterile Water for Injection by direct inoculation method.
12	Sterility testing of Sterile cotton by direct inoculation method.
13	Bacteriological analysis of water

- a. **Course Name:** Pharmaceutical Engineering Lab
- b. **Course Code:** BP 308P
- c. **Prerequisite:** Students should have a background in Biology, Physics, and Chemistry.
- d. **Rationale:** This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know various unit operations used in Pharmaceutical industries.
<b>CLOBJ 2</b>	To understand the material handling techniques.
<b>CLOBJ 3</b>	To perform various processes involved in pharmaceutical manufacturing process.
<b>CLOBJ 4</b>	To carry out various test to prevent environmental pollution.
<b>CLOBJ 5</b>	To appreciate and comprehend significance of plant lay out design for optimum use of resources.
<b>CLOBJ 6</b>	To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Know about the various unit operations like flow of fluids, size reduction and size separation used in pharmaceutical industries.
<b>CLO 2</b>	Understanding the unit operations like Heat Transfer, Evaporation and Distillation
<b>CLO 3</b>	Demonstration of unit operation like drying and mixing used in pharmaceutical industry.
<b>CLO 4</b>	Gain the knowledge of materials used for pharmaceutical plant construction and understand the processes like filtration and centrifugation.
<b>CLO 5</b>	Demonstrate the practical aspect of various engineering-based unit operations.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme		
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>Internal Evaluation</b>	<b>ESE</b>	<b>Total</b>

				<b>MSE</b>	<b>CE</b>	<b>P</b>	<b>Theory</b>	<b>P</b>	
	-	4	2			15		35	50

**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Text Book and Reference Book:**

1. Introduction to chemical engineering – Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson Latest edition.
3. Unit operation of chemical engineering – McCabe 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.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To Determine radiation constant of brass, iron, unpainted and painted glass.
2	To perform Steam distillation & to calculate the efficiency of steam distillation.
3	To determine the overall heat transfer coefficient by heat exchanger.
4	To study the drying curve for calcium carbonate & starch.
5	To determine Loss on drying (LOD) and Moisture content of given sample.
6	To determine humidity of air from wet & dry bulb temperature using dew point method.

7	To evaluate particle size distribution of tablet granules using sieving method with construction of various size frequency curve including arithmetic and logarithmic probability plots.
8	To carry out particle size reduction by ball mill and determine Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
9	To demonstrate tablet compression machine, freeze dryer, Fluidized bed dryer, colloid mill & planetary mixer.
10	A) To study the effect of Surface area on rate of filtration.
11	B) To study the effect of filter medium thickness on rate of filtration.
12	To study the effect of viscosity on rate of filtration.
13	To study the effect of concentration on rate of filtration.
14	A) To study the effect of temperature on rate of evaporation.
15	B) To study the effect of Surface area on rate of evaporation.

#### Semester IV

- a. **Course Name:** Medicinal Chemistry-I Lab
- b. **Course Code:** BP406P
- c. **Prerequisite:** Students should have a basic concept of organic and inorganic chemistry.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the chemistry of drugs with respect to their pharmacological activity
<b>CLOBJ 2</b>	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs

<b>CLOBJ 3</b>	Know the Structural Activity Relationship (SAR) of different class of drugs
<b>CLOBJ 4</b>	Write the chemical synthesis of some drugs
<b>CLOBJ 5</b>	Understand the Preparation of drugs/intermediates and perform assay of drugs

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Introduction to medicinal chemistry, Physicochemical properties of drug in relation to biological action and drug metabolism
<b>CLO 2</b>	Explain and classify Drugs acting on Autonomic Nervous System, Structure activity relationship and synthesis of selective drugs.
<b>CLO 3</b>	Study of Cholinergic neurotransmitters, structure-activity relationship and synthesis of selective drugs.
<b>CLO 4</b>	Explain and classify Drugs acting on Central Nervous System, structure activity relationship and synthesis of selective drugs.
<b>CLO 5</b>	Prepare drugs/intermediates, perform assay of drugs and determine partition coefficient.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To prepare and submit Barbituric acid from diethyl malonate.
2	To prepare and submit Phenytoin from Benzoin.
3	To prepare and submit Benzocaine from PABA.
4	To prepare and submit Phenothiazine.
5	To prepare and submit 2, 3-diphenylquinoxaline
6	To prepare and submit Benztriazole.
7	To prepare and submit benzimidazole.
8	To carry out the assay of Ibuprofen
9	To carry out the assay of Aspirin powder
10	To carry out the assay of Phenobarbitone Sodium
11	To carry out the assay of Chlorpromazine
12	To carry out the assay of Frusemide
13	To carry out the assay of Atropine Sulphate
14	To determine the partition coefficient for distribution of Phenyl butazone between octanol and water.
15	To determine the partition coefficient for distribution of Iodine between CCl <sub>4</sub> and water.

- a. **Course Name:** Physical Pharmaceutics II lab
- b. **Course Code:** BP407P
- c. **Prerequisite:** Students should have a basic understanding of Dosage forms and its formulation.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand various physicochemical properties of drug molecules in the designing the dosage forms
<b>CLOBJ 2</b>	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
<b>CLOBJ 3</b>	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
<b>CLOBJ 4</b>	To understand the practical aspects of physico chemical properties in dosage form design.

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Compare properties, formulate, and evaluate coarse and colloidal dispersions
<b>CLO 2</b>	Illustrate the concept of Rheology and contrast the deformation of solids
<b>CLO 3</b>	Classify micromeritic properties of drug molecules in development and characterization of dosage forms.
<b>CLO 4</b>	Explain the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
<b>CLO 5</b>	Practical aspects of physico chemical properties in dosage form design.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### **h. Text Book and Reference Book:**

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.

#### **i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
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	Determination of angle of repose of given powder and study effect of particle size on it.
5	Determination of influence of lubricant on angle of repose
6	Determination of viscosity of liquid using Ostwald's viscometer
7	Determination of sedimentation volume with effect of different suspending agent
8	Determination of sedimentation volume with effect of different concentration of a single suspending agent
9	Determination of viscosity of semisolid by using Brook field viscometer
10	Determination of reaction rate constant first order

11	Determination of reaction rate constant second order
12	Accelerated stability studies
13	Preparation and physical stability evaluation of sulphur colloid
14	Determination of globule size of emulsion and to determine type of emulsion using suitable method.
15	Determination of particle size, particle size distribution using sieving method

a. **Course Name:** Pharmacology-I Lab

b. **Course Code:** BP408P

c. **Prerequisite:** Students should have a background in Biology, Human Anatomy & Physiology and chemistry.

d. **Rationale:** 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.

e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the pharmacological actions of different categories of drugs
<b>CLOBJ 2</b>	Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
<b>CLOBJ 3</b>	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases
<b>CLOBJ 4</b>	Observe the effect of drugs on animals by simulated experiments
<b>CLOBJ 5</b>	Appreciate correlation of pharmacology with other bio medical sciences

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacology and pharmacokinetics
<b>CLO 2</b>	Understand the pharmacological actions of drugs acting on Autonomic Nervous System, Structure activity relationship and illustrate synthesis of selective drugs.
<b>CLO 3</b>	Understand the pharmacology of drugs acting on peripheral nervous system
<b>CLO 4</b>	Explain the treatments of various neurodegenerative and psychological diseases of central nervous system.
<b>CLO 5</b>	Study of the basics of pharmacological experiments, ethics, and observe the effect of drugs on animals by simulated experiments

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

**L-** Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

**h. Text Book and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill 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

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,

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
1	Introduction to experimental pharmacology.
2	Study of commonly used instruments in experimental pharmacology.
3	Study of common laboratory animals.
4	To study the Maintenance of laboratory animals as per CPCSEA guidelines.
5	Study of Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics 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	To study the effect of drugs on ciliary motility of frog oesophagus
9	To study the effect of drugs on rabbit eye.
10	To study the effects of skeletal muscle relaxants using rota-rod apparatus.
11	To study the effect of drugs on locomotor activity using Actophotometer.
12	To study the 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 anaesthetics by different methods

- a. **Course Name:** Pharmacognosy and Phytochemistry-I lab
- b. **Course Code:** BP409P
- c. **Prerequisite:** Students should have a basic concept of Botany, Biology and Chemistry.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	To know the techniques in the cultivation and production of crude drugs
<b>CLOBJ 2</b>	To know the crude drugs, their uses and chemical nature
<b>CLOBJ 3</b>	Know the evaluation techniques for the herbal drugs
<b>CLOBJ 4</b>	To carry out the microscopic and morphological evaluation of crude drugs

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Explain the basics of pharmacognosy and quality control parameters of herbal drugs
<b>CLO 2</b>	Make use of the techniques in the cultivation, collection, processing, and storage of herbal drugs
<b>CLO 3</b>	Extend the knowledge of plant tissue culture and study of biological source, chemical nature and uses of drugs of natural origin
<b>CLO 4</b>	Develop the pharmacogenetic profile of plant metabolites and role of pharmacognosy in various systems of medicine
<b>CLO 5</b>	Carry out the experiments on the microscopic and morphological characteristics of crude drugs

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. **Text Book and Reference Book:**

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

2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988
3. 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), 1st Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr. SH. Ansari, 2nd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. Iyengar

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia (iii) Agar (iv) starch (v) Honey
2	Analysis of crude drugs by chemical tests: (i) Gelatin (ii) Castor oil
3	Determination of size of starch grains by eye piece micrometer
4	Determination of Ash value
5	Determination of Fiber length and width
6	Determination of moisture content of crude drugs
7	Determination of Extractive values of crude drugs
8	Determination of swelling index.
9	Determination of foaming index
10	Determination of number of starch grains by Lycopodium spore method
11	Determination of stomatal number and index.

12	Determination of vein islet number.
13	Determination of vein termination
14	Determination of palisade ratio.
15	Determination of size of calcium oxalate crystals by eye piece micrometer.

### Semester 5

- a. **Course Name:** Industrial Pharmacy-I Lab
- b. **Course Code:** BP506P
- c. **Prerequisite:** Students should have the basic knowledge of pharmaceutical science of dosage forms.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Know the various pharmaceutical dosage forms and their manufacturing techniques.
<b>CLOBJ 2</b>	Know various considerations in development of pharmaceutical dosage forms
<b>CLOBJ 3</b>	Formulate solid, liquid and semisolid dosage forms and evaluate them for their

- f. **Course Learning Outcomes:**

<b>CLO 1</b>	Study the physicochemical characteristics of drug substances and classify the considerations in development of tablets
<b>CLO 2</b>	Study and compare considerations in development of Liquid orals, Capsules and pellets
<b>CLO 3</b>	Outline various considerations in development of Parenteral Products and Ophthalmic Preparations
<b>CLO 4</b>	Know and demonstrate various considerations in development of cosmetics and Pharmaceutical Aerosols and understand the Packaging Materials Science
<b>CLO 5</b>	Prepare and evaluate pharmaceutical dosage forms

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.
9. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5thedition, 2005

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To carryout Preformulation studies on Paracetamol/ Aspirin.
2	To demonstrate the Tablet Compression Machine.
3	To prepare and evaluate Aspirin tablets by Direct compression method.
4	To perform Preformulation studies on tableting mixture prepared by Wet granulation.
5	To prepare and evaluate Paracetamol tablets wet granulation.
6	To prepare and evaluate Paracetamol tablets by dry granulation.
7	To carryout Coating of tablets- film coating of tables/granules.
8	To prepare and evaluate Tetracycline capsules.
9	To prepare and evaluate Calcium Gluconate injection.
10	To prepare and evaluate Ascorbic Acid injection.
11	To carryout Quality control tests (as per IP) of marketed tablets and capsules.
12	To prepare and evaluate Eye drops and Eye ointment.
13	To prepare and evaluate Cold Creams.
14	To prepare and evaluate Vanishing cream.

- a. **Course Name:** Pharmacology-II Lab  
 b. **Course Code:** BP507P  
 c. **Prerequisite:** Students should have the basic knowledge of anatomy and physiology and chemistry.  
 d. **Rationale:** 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.  
 e. **Course Learning Objective:**

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

f. **Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting directly on the cardiovascular system
<b>CLO 2</b>	Compare the pharmacology of the drugs acting indirectly on the cardiovascular and urinary system
<b>CLO 3</b>	Explain the pharmacology of autocooids and related drugs.
<b>CLO 4</b>	Illustrate the pharmacology of drugs acting on the endocrine system and study of the basic concept of bioassay.
<b>CLO 5</b>	Demonstrate the effect of various drugs on isolated tissues preparation and on whole animals by stimulated experiments.

g. **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### **h. Text Book and Reference Book:**

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
3. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
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
7. 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. Vallabh Prakashan.

#### **i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	Introduction to experimental pharmacology.
2	Study of commonly used instruments in experimental pharmacology.
3	Study of common laboratory animals.
4	To study the Maintenance of laboratory animals as per CPCSEA guidelines.
5	Study of Common laboratory techniques. Blood withdrawal, serum and plasma separation, anaesthetics 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	To study the effect of drugs on ciliary motility of frog oesophagus

9	To study the effect of drugs on rabbit eye.
10	To study the effects of skeletal muscle relaxants using rota-rod apparatus.
11	To study the effect of drugs on locomotor activity using Actophotometer.
12	To study the 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 anaesthetics by different methods

**a. Course Name:** Pharmacognosy and Phytochemistry- II Lab

**b. Course Code:** BP508P

**c. Prerequisite:** Students should have the basic knowledge of Botany and Chemistry

**d. Rationale:** The main purpose of subject is to impart the students the knowledge of how the secondary metabolites is 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

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	To know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
<b>CLOBJ 2</b>	To understand the herbal drug interactions
<b>CLOBJ 3</b>	To understand the preparation and development of herbal formulation.
<b>CLOBJ 4</b>	To carryout isolation and identification of phytoconstituents

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand the basic metabolic pathways and study the basics of phytochemistry
<b>CLO 2</b>	Study of the pharmacognostic profile of Secondary plant metabolites and their commercial applications.

<b>CLO 3</b>	Understanding the isolation, identification, utilization, and estimation of phytoconstituents.
<b>CLO 4</b>	Understand modern extraction methods, spectroscopic and chromatographic techniques for crude drugs
<b>CLO 5</b>	Understand practical aspects of identification, isolation, and analysis of crude drugs.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & 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, NewDelhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, NewDelhi, 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. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
9. The formulation and preparation of cosmetic, fragrances and flavours.

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
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1	Morphology, histology and powder characteristics & extraction & detection of:
2	Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
3	Exercise involving isolation & detection of active principles
4	a. Caffeine - from tea dust.
5	b. Diosgenin from Dioscorea
6	c. Atropine from Belladonna
7	d. Sennosides from Senna
8	Separation of sugars by Paper chromatography TLC of herbal extract
9	Distillation of volatile oils and detection of phytoconstituents by TLC

### Semester 6

**a. Course Name:** Medicinal chemistry-III Lab

**b. Course Code:** BP607P

- c. Prerequisite:** Students should have the basic knowledge of anatomy physiology and organic chemistry
- d. Rationale:** 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.
- e. Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the importance of drug design and different techniques of drug design.
<b>CLOBJ 2</b>	Understand the chemistry of drugs with respect to their biological activity.
<b>CLOBJ 3</b>	Know the metabolism, adverse effects and therapeutic value of drugs.
<b>CLOBJ 4</b>	Know the importance of SAR of drugs.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Explain history, nomenclature, stereochemistry chemical degradation, classification and SAR of $\beta$ -Lactam, Aminoglycosides and Tetracyclines antibiotics
<b>CLO 2</b>	Study the MOA, classification of Macrolide, Antimalarials and miscellaneous drugs with the SAR, synthesis of selective drugs and prodrug concept
<b>CLO 3</b>	Describe the MOA, classification of Anti-tubercular, UTI, anti-infective and Antiviral agents with the SAR and synthesis of selective drugs.
<b>CLO 4</b>	Study the details of Antifungal, Anthelmintics, Sulphonamides and Sulfones and other antimicrobial agents with the SAR and synthesis of selective drugs. Also understand the basic concept of drug design and combinatorial chemistry.
<b>CLO 5</b>	Synthesize drugs and intermediates, perform assay and determine the physicochemical properties of drugs by using drug design software

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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 Marcel Dekker Series, Vol 107.

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To synthesize Sulphanilamide (P-Aminobenzene Sulphonamide)
2	To Synthesize and submit 7-hydroxy coumarin from resorcinol.
3	Synthesis of Chlorobutanol (1, 1, 1-Trichloro-2-Methyl-2-Propanol)
4	To prepare and submit 2, 4, 5-Triphenylimidazole.
5	To prepare and submit hexamine from formaldehyde
6	To carry out the assay of Isoniazid
7	To carry out the assay of Assay of Chloroquine
8	To carry out the assay of Metronidazole
9	To carry out the assay dapsone
10	To carry out the assay chlorpheniramine
11	To carry out the assay of benzyl penicillin
12	Synthesis of tetrahydro pyrimidine derivative by Microwave assisted technique (Biginelli condensation)
13	Synthesis of Phenytoin from Benzil by Microwave assisted technique
14	To draw chemical structure and reaction schemes using ChemDraw software.
15	To determine physicochemical and druglikeness using free online drug design web services.

**a. Course Name:** Pharmacology-III Lab

**b. Course Code:** BP608P

**c. Prerequisite:** Students should have the basic knowledge of anatomy physiology and chemistry.

**d. Rationale:** 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

**e. Course Learning Objective:**

<b>CLOBJ 1</b>	understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
<b>CLOBJ 2</b>	comprehend the principles of toxicology and treatment of various poisonings
<b>CLOBJ 3</b>	Appreciate correlation of pharmacology with related medical sciences.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Understand pharmacology of drugs acting on respiratory system and gastrointestinal tract system.
<b>CLO 2</b>	Compare the principles of chemotherapy and study of the mechanism of action of antibiotics
<b>CLO 3</b>	Demonstrate the pharmacology of various chemotherapeutic agents.
<b>CLO 4</b>	Illustrate pharmacology of drugs acting on immune system and Learn the principles of toxicology and chrono pharmacology
<b>CLO 5</b>	Practicality understand the pyrogen testing, Conduct toxicity studies and apply biostatistics.

**g. Teaching & Examination Scheme:**

<b>Teaching Scheme</b>	<b>Evaluation Scheme</b>
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L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

#### h. Text Book and Reference Book:

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
3. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
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
7. 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. Vallabh Prakashan.

#### i. Mapping of Experiment List with Course Learning Outcomes:

Sr. No.	Experiment List
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)

- a. **Course Name:** Herbal Drug Technology Lab
- b. **Course Code:** BP609P
- c. **Prerequisite:** Students should have the basic knowledge of Pharmacognosy and technology.
- d. **Rationale:** 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
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand raw material as source of herbal drugs from cultivation to herbal drug product
<b>CLOBJ 2</b>	Know the WHO and ICH guidelines for evaluation of herbal drugs
<b>CLOBJ 3</b>	Know the herbal cosmetics, natural sweeteners, nutraceuticals
<b>CLOBJ 4</b>	Appreciate patenting of herbal drugs, GMP.

**f. Course Learning Outcomes:**

<b>CLO 1</b>	Make a use of raw material as source of herbal drugs from cultivation to herbal drug product & ISM formulations.
<b>CLO 2</b>	Learn the general aspects of herbal industry, Schedule T, Nutraceuticals & know about the interaction of herbs with drugs and food.
<b>CLO 3</b>	Demonstrate the Natural excipients & herbal formulations.
<b>CLO 4</b>	Apply the WHO & ICH guidelines for the evaluation of herbal drugs, Indian patenting and regulatory requirements.
<b>CLO 5</b>	Construct the practical knowledge of determination of plant Metabolites and preparation & standardization of herbal formulations.

**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	-	-	4	15	10	-	75	-	100
		4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

6. Textbook of Pharmacognosy by Trease & Evans.
7. Textbook of Pharmacognosy by Tyler, Brady & Robber.
8. Pharmacognosy by Kokate, Purohit and Gokhale
9. Essential of Pharmacognosy by Dr.S.H.Ansari
10. Pharmacognosy & Phytochemistry by V.D.Rangari

11. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
12. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002

**i. Mapping of Experiment List with Course Learning Outcomes:**

<b>Sr. No.</b>	<b>Experiment List</b>
1	To perform preliminary phytochemical screening of crude drugs (Drugs containing Alkaloids, Tannin, Resin).
2	To perform preliminary phytochemical screening of crude drugs (Drugs containing Glycosides, Volatile).
3	Determination of the alcohol content of Asava and Arista.
4	Evaluation of excipients of natural origin (Acacia, Agar, Tragacanth, Gelatin, Guar gum).
5	Incorporation of extract in cosmetic formulation - cream and its evaluation.
6	Incorporation of extract in cosmetic formulation - lotion and its evaluation.
7	Incorporation of extract in cosmetic formulation - shampoo and its evaluation.
8	Incorporation of extract in syrup and its evaluation as per Pharmacopoeial requirements.
9	Incorporation of extract in mixture and its evaluation as per Pharmacopoeial requirements.
10	Incorporation of extract in tablet and its evaluation as per Pharmacopoeial requirements.
11	Monograph analysis of herbal drug (Amla) from recent Pharmacopoeias (IP).
12	Monograph analysis of herbal drug (Turmeric) from recent Pharmacopoeias (IP).
13	Determination of Aldehyde content.
14	Determination of Phenol content.
14	Determination of total alkaloids.
15	To perform preliminary phytochemical screening of crude drugs (Drugs containing Alkaloids, Tannin, Resin).

## Semester VII

- a. **Course Name:** Instrumental Methods of Analysis Lab
- b. **Course Code:** BP705P
- c. **Prerequisite:** Students should have the basic knowledge of pharmaceutics and pharmacology.
- d. **Rationale:** 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.
- e. **Course Learning Objective:**

<b>CLOBJ 1</b>	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
<b>CLOBJ 2</b>	Understand the chromatographic separation and analysis of drugs.
<b>CLOBJ 3</b>	Perform quantitative & qualitative analysis of drugs using various analytical instruments.

### f. Course Learning Outcomes:

<b>CLO 1</b>	Interaction of Electromagnetic radiation with matter, Spectroscopic technique including UV-Visible and Fluorimetry theory, Instrumentation and Application
<b>CLO 2</b>	Spectroscopic technique like IR, Flame photometry, atomic absorption and Nephelometry.
<b>CLO 3</b>	Chromatographic separation and analysis including TLC, Paper, Column chromatography and HPLC
<b>CLO 4</b>	Advanced chromatographic methods like Gas, ion exchange, affinity and gel chromatography theory, instrumentation and applications; Electrophoresis – theory and application

<b>CLO 5</b>	Qualitative and quantitative analysis of drug using instrumental analytical techniques
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**g. Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
	-	4	2			15		35	50

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

**h. Text Book and Reference Book:**

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

**i. Mapping of Experiment List with Course Learning Outcomes:**

Sr. No.	Experiment List
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

