JSPM University Pune

Faculty of Health Sciences

School of Pharmaceutical Sciences

Pharmacy Council of India

New Delhi

Syllabus

for

Bachelor of Pharmacy (F. Y. B. Pharm) Course

(Effective from AY: 2023-24)

JSPM University Pune

COURSE STRUCTURE
(AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)

FACULTY OF HEALTH SCIENCES	**W. E. F**	**2023-2024**
SCHOOL OF PHARMACEUTICAL SCIENCES	**RELEASE DATE**	**01/07/2023**
FIRST YEAR BACHELOR OF PHARMACY	**REVISION NO.**	**0.0 (PCI, New Delhi)**

SEMESTER I

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS								TOTAL MARKS	CREDITS
			Hours/ Week				THEORY				PRACTICAL					
							INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)		
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL			
NA	BP101T	Human Anatomy and Physiology I– Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP102T	Pharmaceutical Analysis I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP103T	Pharmaceutics I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP105T	Communication skills – Theory *	2	-	-	-	5	10	15	35	-	-	-	-	50	2
NA	BP106RBT BP106RMT	Remedial Biology / Remedial Mathematics – Theory*	2	-	-	-	5	10	15	35	-	-	-	-	50	2
NA	BP107P	Human Anatomy and Physiology I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP108P	Pharmaceutical Analysis I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP109P	Pharmaceutics I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP110P	Pharmaceutical Inorganic Chemistry – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP111P	Communication skills – Practical*	-	-	2	-	-	-	-	-	5	5	10	15	25	1
NA	BP112RBP	Remedial Biology – Practical*	-	-	2	-	-	-	-	-	5	5	10	15	25	1
		Total	**16**	**4**	**20**	-	**45/50#/ 50$**	**70/80$/ 80#**	**115/ 130#/ 130$**	**370**	**25/25$/ 30#**	**45/50#/ 45$**	**70/70$/ 80#**	**155/155$/ 170#**	**675/ 725$ / 750#**	**27/29$/ 30#**

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course
$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.
*** Non University Examination (NUE)**

JSPM University Pune

COURSE STRUCTURE
(AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)

FACULTY OF HEALTH SCIENCES		**W. E. F.**	**2023-2024**
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SEMESTER II

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS											CREDITS
			Hours/ Week				THEORY				PRACTICAL				ORAL (Equal Weightage for CIE and ESE)		TOTAL MARKS	
TYPE	CODE	COURSE NAME	L	T	P	EL	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	CONTINUOUS INSEMESTER EVALUATION (Marks)	END SEMESTER EXAMINATION (Marks)		
							CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL					
NA	BP201T	Human Anatomy and Physiology II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP202T	Pharmaceutical Organic Chemistry I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP203T	Biochemistry – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP204T	Pathophysiology – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP205T	Computer Applications in Pharmacy – Theory*	3	-	-	-	10	15	25	50	-	-	-	-	-	-	75	3
NA	BP206T	Environmental sciences – Theory*	3	-	-	-	10	15	25	50	-	-	-	-	-	-	75	3
NA	BP207P	Human Anatomy and Physiology II – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP208P	Pharmaceutical Organic Chemistry I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP209P	Biochemistry – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP210P	Computer Applications in Pharmacy – Practical*	-	-	2	-	-	-	-	-	5	5	10	15	-	-	25	1
NA	BP211	Internship	4 to 6 Weeks				-	-	-	-	-	-	-	-	50	50	100	2
Total			**18**	**4**	**14**	-	**60**	**90**	**150**	**400**	**20**	**35**	**55**	**120**	**50**	**50**	**825**	**31**

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: HUMAN ANATOMY AND PHYSIOLOGY I (Theory)**	
Course Code: BP101T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

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

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Explain gross morphology, structure and functions of various organs of the human body.

CO2: Describe the various homeostatic mechanisms and their imbalances in human body.

CO3: Identify the various cellular and tissues levels of organization in human anatomy.

CO4: Understand anatomy and physiology special senses and anatomical systems like skeletal system, cardiovascular system, nervous system, lymphatic system and body fluids.

CO5: Understand coordinated working pattern of different organs of each system.

CO6: Understand and explain organs system of human body and their interrelationships.

Course Contents		
Unit I		**(10 Hrs)**

- **Introduction to human body**

Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

- **Cellular level of organization**

Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

- **Tissue level of organization**

Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit II		**(10 Hrs)**

- **Integumentary system**

Structure and functions of skin

- **Skeletal system**

Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction.

- **Joints**

Structural and functional classification, types of joints movements and its Articulation.

Unit III		**(10 Hrs)**

- **Body fluids and blood**
- Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo-endothelial system.
- **Lymphatic system**

  Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

Unit IV		**(08 Hrs)**

- **Peripheral nervous system**:

  Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.

- **Special senses**

  Structure and functions of eye, ear, nose and tongue and their disorders.

Unit V		**(07 Hrs)**

- **Cardiovascular system**

Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **HUMAN ANATOMY AND PHYSIOLOGY I (Practical)**	
Course Code: BP107P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Demonstrate a comprehensive understanding of compound microscopes and perform microscopic studies of epithelial, connective, muscular, and nervous tissues.

CO2: Identify axial and appendicular bones and understand the human skeletal anatomy.

CO3: Understand concept of hemocytometry and its use during experiment.

CO4: Enumerate white blood cell (WBC) count, total red blood corpuscles (RBC) count, bleeding time, clotting time, and estimation of haemoglobin content.

CO5: Determine own blood group, blood pressure, heart rate, pulse rate.

CO6: Estimate erythrocyte sedimentation rate (ESR).

List of Laboratory Experiments

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.

Learning Resources

Text Books (Latest Editions):

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

Reference Books (Latest Editions):

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

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: PHARMACEUTICAL ANALYSIS I (Theory)**	
Course Code: BP102T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

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

- Understand the principles of volumetric and electro chemical analysis.
- Carryout various volumetric and electrochemical titrations.
- Develop analytical skills.

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the concept of and techniques involved in pharmaceutical analysis.

CO2: Know the methods of preparation and standardization of various molar and normal Solutions.

CO3: Know the concept and meaning of errors, pharmacopoeia, sources of impurities, principles and types of limit tests.

CO4: Understand the Principles of volumetric analysis.

CO5: Understand the Principles of Electrochemical methods of analysis.

CO6: Know assay procedures of different compounds.

Course Contents		
Unit I		**(10 Hrs)**

(a) Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c) Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

Unit II		**(10 Hrs)**

- **Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves.
- **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl.

Unit III		**(10 Hrs)**

- **Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.
- **Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.
- **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.
- Basic Principles, methods and application of diazotisation titration.

Unit IV		**(08 Hrs)**

Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications), Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate.

Unit V		**(07 Hrs)**

Electrochemical methods of analysis

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

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL ANALYSIS I (Practical)**	
Course Code: BP108P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Perform limit tests of Chloride, Sulphate, Iron and Arsenic.

CO2: Prepare various normal and molar solutions.

CO3: Perform standardization of solutions.

CO4: Perform assay of compounds along with standardization of titrants.

CO5: Determine normality of solutions by Conductometric titration method.

CO6: Determine normality of solutions by potentiometric titration method.

List of Laboratory Experiments	
I	**Limit Test of the following**
(1)	Chloride
(2)	Sulphate
(3)	Iron
(4)	Arsenic
II	**Preparation and standardization of**
(1)	Sodium hydroxide
(2)	Sulphuric acid
(3)	Sodium thiosulfate

(4)	Potassium permanganate
(5)	Ceric ammonium sulphate
III	**Assay of the following compounds along with Standardization of Titrant**
(1)	Ammonium chloride by acid base titration
(2)	Ferrous sulphate by Cerimetry
(3)	Copper sulphate by Iodometry
(4)	Calcium gluconate by Complexometry
(5)	Hydrogen peroxide by Permanganometry
(6)	Sodium benzoate by non-aqueous titration
(7)	Sodium Chloride by precipitation titration
IV	**Determination of Normality by electro-analytical methods**
(1)	Conductometric titration of strong acid against strong base
(2)	Conductometric titration of strong acid and weak acid against strong base
(3)	Potentiometric titration of strong acid against strong base

Learning Resources

Recommended Books (Latest Editions):

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.

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: PHARMACEUTICS I (Theory)**	
Course Code: BP103T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.		
Course Objectives: Upon completion of this course the student should be able to: • Know the history of profession of pharmacy. • Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations. • Understand the professional way of handling the prescription. • Preparation of various conventional dosage forms.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Describe the history of profession of pharmacy. **CO2:** Demonstrate understanding of the basics of different dosage forms (powders, liquid dosage forms, monophasic & biphasic liquids, suppositories & Semisolid dosage forms). **CO3:** Demonstrate Understanding of the basics of Pharmaceutical incompatibilities and Pharmaceutical calculations. **CO4:** Demonstrate Understanding of the professional way of handling the prescription. **CO5:** Prepare various conventional dosage forms such as powders, liquids dosage forms; monophasic and biphasic. **CO6:** Prepare various conventional dosage forms such as suppositories and semisolid dosage forms.		
Course Contents		
Unit I		**(10 Hrs)**

- **Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.
- **Dosage forms:** Introduction to dosage forms, classification and definitions
- **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription.
- **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

Unit II		**(10 Hrs)**

- **Pharmaceutical calculations**: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.
- **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.
- **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

Unit III		**(10Hrs)**

- **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.
- **Biphasic liquids:**
- **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.
- **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

Unit IV		**(08 Hrs)**

- **Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.
- **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

Unit V		(07 Hrs)
• **Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms.		

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTIS I (Practical)**	
Course Code: BP109P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the principles used in the preparation of solid, liquid and semi solid dosage forms.

CO2: Understand preparation of labels for various dosage forms.

CO3: Describe use of ingredients in formulation and category of formulation.

CO4: Prepare various conventional dosage forms such as monophasic liquid dosage forms for internal and external administration.

CO5: Prepare various conventional dosage forms such as biphasic liquid dosage forms.

CO6: Prepare various conventional dosage forms such as powders and granules and suppositories and semisolid dosage forms.

List of Laboratory Experiments

1 .	**Syrups**
a)	Syrup IP'66
b)	Compound syrup of Ferrous Phosphate BPC'68
2.	**Elixirs**
a)	Piperazine citrate elixir
b)	Paracetamol pediatric elixir
3.	**Linctus**
a)	Terpin Hydrate Linctus IP'66
b)	Iodine Throat Paint (Mandles Paint)
4.	**Solutions**
a)	Strong solution of ammonium acetate

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

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)**	
Course Code: BP104T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.		
Course Objectives: Upon completion of course student shall be able to • Know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals. • Understand the medicinal and pharmaceutical importance of inorganic compounds.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Know the concept and Introduction to Pharmaceutical Inorganic Chemistry. **CO2:** Study the concepts and monographs of inorganic drugs and pharmaceuticals. **CO3:** Know the sources of impurities and methods to determine the impurities in drugs and pharmaceuticals. **CO4:** Understand the medicinal and pharmaceutical importance of inorganic compounds. **CO5:** Understand general methods of preparation and assay for compounds. **CO6:** Study properties and Medicinal uses of Inorganic Compounds belong to the various classes.		
Course Contents		
Unit I		**(10 Hrs)**

- **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

  General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes.

Unit II		**(10 Hrs)**

- **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.
- **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.
- **Dental products**: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

Unit III		**(10 Hrs)**

- **Gastrointestinal agents**

Acidifiers: Ammonium chloride* and Dil. HCl

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

Unit IV		**(08 Hrs)**

- **Miscellaneous compounds**

Expectorants: Potassium iodide, Ammonium chloride*.

Emetics: Copper sulphate*, Sodium potassium tartarate

Haematinics: Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite

Astringents: Zinc Sulphate, Potash Alum

Unit V		**(07 Hrs)**

- **Radiopharmaceuticals**: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)**	
Course Code: BP110P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: To perform limit test for chlorides, sulphate, iron, heavy metal, lead and arsenic.

CO2: To perform modified limit test for chlorides and sulphates.

CO3: Perform identification test for magnesium hydroxide, ferrous sulphate, sodium bicarbonate, calcium gluconate and copper sulphate.

CO4: To perform test for purity of inorganic pharmaceuticals.

CO5: To perform preparation of Inorganic pharmaceuticals-Boric acid and Ferrous Sulphate.

CO6: To perform preparation of Inorganic pharmaceuticals-Potash Alum.

List of Laboratory Experiments

I	**Limit tests for following ions** Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic
II	**Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate

	Copper sulphate
III	**Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide
IV	**Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: COMMUNICATION SKILLS (Theory)**	
Course Code: BP105T	**Teaching Scheme: 2 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L): 2** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

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

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

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Communicate effectively (Verbal and Non Verbal).

CO2: Effectively manage the team as a team player.

CO3: Develop interview skills.

CO4: Develop Leadership qualities and essentials.

CO5: Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation.

CO6: Develop Leadership qualities and essentials.

Course Contents

Unit I		**(07 Hrs)**

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

Unit II		**(07 Hrs)**

- **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication
- **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

Unit III		**(07 Hrs)**

- **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations
- **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication
- **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

Unit IV		**(05 Hrs)**

- **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview
- **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

Unit V		**(04Hrs)**

- **Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion.

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: COMMUNICATION SKILLS (Practical)**	
Course Code: BP111P	**Teaching Scheme: 2 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L):** **Tutorial (T):** **Practical (P): 2** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 25 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Develop interview skills, Group discussion.

CO2: Write E-Mail With Etiquettes.

CO3: Improve Presentation skills.

CO4: Learn how to talk with our friends.

CO5: Develop Leadership qualities and essentials.

CO6: Learn how to do Pronunciations.

List of Laboratory Experiments

The following learning modules are to be conducted using wordsworth® English language lab software.

I	**Basic communication covering the following topics** Meeting People Asking Questions Making Friends What did you do? Do's and Dont's
II	**Pronunciations covering the following topics** Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds)
III	**Advanced Learning**

	Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills

Learning Resources

Recommended Books (Latest Editions):

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, 5thEdition, Pearson, 2013.
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010.
7. Communication skills for professionals, Konar nira, 2nd Edition, New arrivals – PHI, 2011.
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011.
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning 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, 4thEdition, Pan Mac Millan, 2009.
12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999.

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: REMEDIAL BIOLOGY (Theory)**	
Course Code: BP106RBT	**Teaching Scheme:2 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L): 2** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.		
Course Objectives: Upon completion of the course, the student shall be able to • Know the classification and salient features of five kingdoms of life. • Understand the basic components of anatomy & physiology of plant. • Know understand the basic components of anatomy & physiology animal with special reference to human.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Know the classification and salient features of five kingdoms of life, understand the diversity in the living world, and gain knowledge of the morphology of plants.

CO2: Comprehend the human circulatory system as well as explore the anatomy of the human alimentary canal, digestive glands, and the role of digestive enzymes.

CO3: Gain insights into structure and function of the human excretory system and understand the nervous system, including nerve impulse generation, and the functions of the brain and spinal cord.

CO4: Explore chemical coordination and regulation through the study of endocrine glands, and examine human reproduction, covering the parts of the male and female reproductive systems.

CO5: Acquire knowledge of essential minerals, macro and micronutrients, study plant respiration and plant growth regulators.

CO6: Understand the structure and functions of cells and cell organelles, explore different types of tissues and functions in organisms.

Course Contents

Unit I		**(07 Hrs)**

Living world:

- Definition and characters of living organisms
- Diversity in the living world
- Binomial nomenclature
- Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus,

Morphology of Flowering plants

- Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed.
- General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.

Unit II		**(07 Hrs)**

Body fluids and circulation

- Composition of blood, blood groups, coagulation of blood
- Composition and functions of lymph
- Human circulatory system
- Structure of human heart and blood vessels
- Cardiac cycle, cardiac output and ECG

Digestion and Absorption

- Human alimentary canal and digestive glands
- Role of digestive enzymes
- Digestion, absorption and assimilation of digested food

Breathing and respiration

- Human respiratory system
- Mechanism of breathing and its regulation
- Exchange of gases, transport of gases and regulation of respiration
- Respiratory volumes

Unit III		**(07 Hrs)**

Excretory products and their elimination

- Modes of excretion
- Human excretory system- structure and function
- Urine formation
- Rennin angiotensin system

Neural control and coordination

- Definition and classification of nervous system
- Structure of a neuron
- Generation and conduction of nerve impulse
- Structure of brain and spinal cord
- Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata

Chemical coordination and regulation

- Endocrine glands and their secretions
- Functions of hormones secreted by endocrine glands

Human reproduction

- Parts of female reproductive system
- Parts of male reproductive system
- Spermatogenesis and Oogenesis
- Menstrual cycle

Unit IV		**(05 Hrs)**

Plants and mineral nutrition:

- Essential mineral, macro and micronutrients
- Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation

Photosynthesis

- Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

Unit V		**(04 Hrs)**

Plant respiration: Respiration, glycolysis, fermentation (anaerobic).

Plant growth and development

- Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators

Cell - The unit of life

- Structure and functions of cell and cell organelles. Cell division

Tissues

- Definition, types of tissues, location and functions.

Learning Resources
Text Books: a. Text book of Biology by S. B. Gokhale. b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.
Reference Books: a. A Text book of Biology by B.V. Sreenivasa Naidu. b. A Text book of Biology by Naidu and Murthy. c. Botany for Degree students By A. C. Dutta. d. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan. e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate.

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: REMEDIAL BIOLOGY (Practical)**	
Course Code: BP112RBP	**Teaching Scheme: 2 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L):** **Tutorial (T):** **Practical (P): 2** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 25 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Develop competence in essential microscope handling skills.

CO2: Acquire a comprehensive understanding of cell structure and practical knowledge in the morphology and modifications of plant organs through direct observation and experimentation.

CO3: Comprehend frog anatomy, enhancing comprehension and engagement in biological sciences through virtual exploration.

CO4: Apply microscopic techniques for the identification and analysis of different type of tissues and develop proficiency in tissue examination.

CO5: Demonstrate the ability to identify and differentiate bones, determine lung volumes.

CO6: Identify the blood group and measure the blood pressure in humans.

List of Laboratory Experiments

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

6.	Identification of bones
7.	Determination of blood group
8.	Determination of blood pressure
9.	Determination of tidal volume

Learning Resources

Reference Books:

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

JSPM University Pune First Year B. Pharmacy Semester- I		
Course Type: NA	**Course Title: REMEDIAL MATHEMATICS (Theory)**	
Course Code: BP106RMT	**Teaching Scheme: 2 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L): 2** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.		
Course Objectives: Upon completion of the course the student shall be able to:- **1.** Know the theory and their application in Pharmacy. **2.** Solve the different types of problems by applying theory. **3.** Appreciate the important application of mathematics in Pharmacy.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Know the theory and their application in Pharmacy. **CO2:** Solve the different types of problems by applying theory. **CO3:** Appreciate the important application of mathematics in Pharmacy. **CO4:** Study Partial fraction, Logarithm, matrices and Determinants. **CO5:** Study analytical geometry, calculus. **CO6:** Study differential equation and Laplace transform.		
Course Contents		
Unit I		**(06 Hrs)**

- **Partial fraction**

Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction , Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

- **Logarithms**

Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

- **Function***:*

Real Valued function, Classification of real valued functions,

- **Limits and continuity** :

Introduction , Limit of a function, Definition of limit of a function (ϵ- δ definition),

$$\lim_{x\to a}\frac{x^n - a^n}{x-a} = na^{n-1}, \qquad \lim_{\theta\to 0}\frac{\sin\theta}{\theta} = 1,$$

Unit II		**(06 Hrs)**

- **Matrices and Determinant:**

Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations

Unit III		**(06 Hrs)**

- **Calculus**

Differentiation : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n *w.r.t*x, where *n* is any rational number, Derivative of e^x,, Derivative of $\log_e x$, Derivative of a^x Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application

Unit IV		**(06 Hrs)**

- **Analytical Geometry**

Introduction: Signs of the Coordinates, Distance formula,

Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

Integration:

Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application

Unit V		**(06 Hrs)**

- **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**
- **Laplace Transform** : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

Learning Resources

Recommended Books (Latest Edition):

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.

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: HUMAN ANATOMY AND PHYSIOLOGY II (Theory)**	
Course Code: BP201T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.		
Course Objectives: Upon completion of this course the student should be able to: 1. Explain the gross morphology, structure and functions of various organs of the human body. 2. Describe the various homeostatic mechanisms and their imbalances. 3. Identify the various tissues and organs of different systems of human body. 4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume. 5. Appreciate coordinated working pattern of different organs of each system. 6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Exhibit a comprehensive understanding of the nervous system**,** electrophysiology, and central nervous system functions.

CO2: Demonstrate proficiency in the anatomy and functions of the digestive system, energetics, and the regulation of acid production**.**

CO3: Understand the respiratory and urinary system concepts, understanding lung anatomy, respiratory mechanisms, gas transport, kidney functions.

CO4: Gain an in-depth knowledge of the endocrine system, mechanisms of hormone action, and the structure and functions of key endocrine glands**.**

CO5: Comprehensive understanding of the male and female reproductive systems, sex hormones, and the physiological processes involved.

CO6: Exhibit a foundational understanding of genetics, and genetic inheritance patterns, fostering insight into the molecular basis of life.

Course Contents

Unit I		**(10 Hrs)**

- **Nervous system**

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid, structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

Unit II		**(06 Hrs)**

- **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

- **Energetics**

Formation and role of ATP, Creatinine Phosphate and BMR.

Unit III		**(10 Hrs)**

- **Respiratory system**

Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration

Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

- **Urinary system**

Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit IV		**(10 Hrs)**

- **Endocrine system**

Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

Unit V		**(09 Hrs)**

- **Reproductive system**

Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

- **Introduction to genetics**

Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: HUMAN ANATOMY AND PHYSIOLOGY II (Practical)**	
Course Code: BP207P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Develop proficiency in studying the integumentary and special senses utilizing specimens, models, and other resources.

CO2: Demonstrate a thorough general neurological examination, showcasing their practical skills in assessing neurological functions.

CO3: Gain practical insights into the various sensory functions like olfactory, gustatory, visual acuity.

CO4: Showcase practical competence in demonstrating reflex activity, recording body temperature and lung capacities.

CO5: Demonstrate an understanding of positive and negative feedback mechanisms, BMI and family planning resources.

CO6: Understand the various body systems with the help of models, charts, specimens as well as principle and application of cell analyser**.**

List of Laboratory Experiments	
1.	To study the integumentary and special senses using specimen, models, etc.
2.	To study the nervous system using specimen, models, etc.
3.	To study the endocrine system using specimen, models, etc.

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

Learning Resources

Recommended Books (Latest Editions)

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

Reference Books:

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

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY I (Theory)**	
Course Code: BP202T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.		
Course Objectives: Upon completion of the course the student shall be able to 1. Write the structure, name and the type of isomerism of the organic compound. 2. Write the reaction, name the reaction and orientation of reactions. 3. Account for reactivity/stability of compounds. 4. Identify/confirm the identification of organic compound.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Know the concept of organic compounds and classification of organic compunds. **CO2:** Understand the common and IUPAC system of nomenclature of organic compounds. **CO3:** Write the chemical structure, name and type of isomerism of organic compounds. **CO4:** Write the chemical reaction and name the reaction. **CO5:** Account for reactivity and stability of organic compounds. **CO6:** Identify and confirm the identification of organic compounds.		
Course Contents		

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained.

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

Unit I		**(07 Hrs)**

- **Classification, nomenclature and isomerism**

Classification of Organic Compounds

Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds)

Structural isomerisms in organic compounds

Unit II		**(10 Hrs)**

- **Alkanes*, Alkenes* and Conjugated dienes***

SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP^2 hybridization in alkenes

E_1 and E_2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E_1 verses E_2 reactions, Factors affecting E_1 and E_2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

Unit III		**(10 Hrs)**

- **Alkyl halides***

SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.

SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions

Structure and uses of ethyl chloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

- **Alcohols*-** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

Unit IV		**(10 Hrs)**

- **Carbonyl compounds* (Aldehydes and ketones)**

Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

Unit V		**(08 Hrs)**

- **Carboxylic acids***

Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester

Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

- **Aliphatic amines* -** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY I (Practical)**	
Course Code: BP208P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

Course Outcomes: On completion of the course, learner will be able to

CO1: Perform systematic qualitative analysis of unknown organic compounds.

CO2: Perform preliminary test, elemental and functional group analysis of organic Compounds.

CO3: Determine melting/boiling point of organic compounds.

CO4: Identify unknown organic compound from literature using melting/boiling point.

CO5: Prepare suitable solid derivatives from organic compounds.

CO6: Perform construction of molecular models.

List of Laboratory Experiments

1.	Systematic qualitative analysis of unknown organic compounds like 1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test 3. Solubility test. 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. 5. Melting point/Boiling point of organic compounds. 6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.

	8. Minimum 5 unknown organic compounds to be analysed systematically.
2.	Preparation of suitable solid derivatives from organic compounds.
3.	Construction of molecular models.

Learning Resources

Recommended Books (Latest Editions)

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

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: BIOCHEMISTRY (Theory)**	
Course Code: BP203T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.		
Course Objectives: Upon completion of course student shell able to 1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes. 2. Understand the metabolism of nutrient molecules in physiological and pathological conditions. 3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Explain the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

CO2: Describe the metabolism of nutrient molecules in physiological and pathological conditions.

CO3: Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

CO4: Perform Qualitative analysis of carbohydrates , reducing sugars and Proteins, urine for abnormal constituents.

CO5: Determine Blood creatinine, sugar, cholesterol.

CO6: Prepare buffer solution and measure Ph/

CO7: Estimate Salivary Amylase activity and study different factors like temperature, substrate.

Course Contents

Unit I		**(08 Hrs)**

- **Biomolecules**

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

- **Bioenergetics**

Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

Unit II		**(10 Hrs)**

- **Carbohydrate metabolism**

Glycolysis – Pathway, energetics and significance, Citric acid cycle- Pathway, energetics and significance, HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, Glycogen metabolism Pathways and glycogen storage diseases (GSD), Gluconeogenesis- Pathway and its significance, Hormonal regulation of blood glucose level and Diabetes mellitus

- **Biological oxidation**

Electron transport chain (ETC) and its mechanism., Oxidative phosphorylation & its mechanism and substrate level phosphorylation, Inhibitors ETC and oxidative phosphorylation / Uncouplers

Unit III		**(10 Hrs)**

- **Lipid metabolism**

β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis, De novo synthesis of fatty acids (Palmitic acid), Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

- **Amino acid metabolism**

General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders, Catabolism of phenylalanine and tyrosine and their metabolic disorders, (Phenylketonuria, Albinism, alkaptonuria, tyrosinemia), Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline, Catabolism of heme; hyperbilirubinemia and jaundice

Unit IV		**(10 Hrs)**

- **Nucleic acid metabolism and genetic information transfer**

Biosynthesis of purine and pyrimidine nucleotides, Catabolism of purine nucleotides and Hyperuricemia and Gout disease, Organization of mammalian genome, Structure of DNA and RNA and their functions, DNA replication (semi conservative model), Transcription or RNA synthesis, Genetic code, Translation or Protein synthesis and inhibitors

Unit V		**(07 Hrs)**

- **Enzymes**

Introduction, properties, nomenclature and IUB classification of enzymes, Enzyme kinetics (Michaelis plot, Line Weaver Burke plot), Enzyme inhibitors with examples, Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation, Therapeutic and diagnostic applications of enzymes and isoenzymes, Coenzymes –Structure and biochemical functions

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: BIOCHEMISTRY (Practical)**	
Course Code: BP209P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Assess and relate the concepts of chemistry to biology.

CO2: Understand the structure, functions and method of identification of fundamental carbohydrates.

CO3: Understand the structures, chemical properties, organization and method of identification of proteins and amino acids.

CO4: Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

CO5: Determine Blood creatinine, sugar, cholesterol.

CO6: Understand the buffering system.

CO7: Understand the metabolism of nutrient molecules in physiological and pathological conditions.

List of Laboratory Experiments

1.	Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch).
2.	Identification tests for Proteins (albumin and Casein).
3.	Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method).
4.	Qualitative analysis of urine for abnormal constituents.
5.	Determination of blood creatinine.
6.	Determination of blood sugar.
7.	Determination of serum total cholesterol.
8.	Preparation of buffer solution and measurement of pH.

9.	Study of enzymatic hydrolysis of starch.
10.	Determination of Salivary amylase activity.
11.	Study the effect of Temperature on Salivary amylase activity.
12.	Study the effect of substrate concentration on salivary amylase activity.

Learning Resources

Recommended Books (Latest Editions)

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

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: PATHOPHYSIOLOGY (THEORY)**	
Course Code: BP204T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

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

Course Objectives: Upon completion of the subject student shall be able to –

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Describe the etiology and pathogenesis of the cell injury, its adaptation and process of inflammation, its repairing.

CO2: Describe the etiology and pathogenesis of the Cardiovascular System.

CO3: Name the signs and symptoms of the Hematological Diseases Endocrine system and Nervous system.

CO4: Explain etiology and pathogenesis of the Diseases of bones and joints.

CO5: Describe the various Infectious diseases.

CO6: Understand the Sexually transmitted diseases.

Course Contents

Unit I		**(10 Hrs)**

- **Basic principles of Cell injury and Adaptation:**

Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury**,** Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage)**,** Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia)**,** Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance

- **Basic mechanism involved in the process of inflammation and repair:**

Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of 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

Unit II		**(10 Hrs)**

- **Cardiovascular System:**

Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)

- **Respiratory system:** Asthma, Chronic obstructive airways diseases.
- **Renal system:** Acute and chronic renal failure.

Unit III		**(10 Hrs)**

- **Haematological Diseases:**

Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia

- **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones
- **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.
- **Gastrointestinal system:** Peptic Ulcer

Unit IV		**(08 Hrs)**

- Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.
- **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout
- **Principles of cancer:** classification, etiology and pathogenesis of cancer
- **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout
- **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer

Unit V		**(07 Hrs)**

- **Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis, Urinary tract infections
- **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea

Learning Resources

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states.
5. William and Wilkins, Baltimore; 1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals:

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

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: COMPUTER APPLICATIONS IN PHARMACY (Theory)**	
Course Code: BP205T	**Teaching Scheme: 3 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.		
Course Objectives: Upon completion of the course the student shall be able to 1. Know the various types of application of computers in pharmacy. 2. Know the various types of databases. 3. Know the various applications of databases in pharmacy.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Know the various types of application of computers in pharmacy. **CO2:** Know the various types of databases. **CO3:** Know the various types of databases. **CO4:** Know the concept of Information Systems & Software. **CO5:** Know the impact of Bioinformatics in Vaccine Discovery. **CO6:** Know the use of Computer as Data Analysis in Preclinical Development.		
Course Contents		
Unit I		**(06 Hrs)**

Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division

Concept of Information Systems and Software: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

Unit II		**(06 Hrs)**

Web technologies: Introduction to HTML, XML, CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

Unit III		**(06 Hrs)**

Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

Unit IV		**(06 Hrs)**

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics

Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

Unit V		**(06 Hrs)**

Computers as data analysis in Preclinical development:

Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)

JSPM UNIVERSITY PUNE
Recognized by the UGC u/s 2 (f) of UGC Act 1956 and enacted by the
State Government of Maharashtra - JSPM University Act, 2022 (Mah. IV of 2023)

JSPM University Pune First Year B. Pharmacy		
Course Type: NA	**Lab Course Title: COMPUTER APPLICATIONS IN PHARMACY (Practical)**	
Course Code: BP210P	**Teaching Scheme: 2 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L):** **Tutorial (T):** **Practical (P): 2** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 25 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

Course Outcomes: On completion of the course, learner will be able to

CO1: Design a questionnaire using a word processing package and Design a form in MS Access to view, add, delete and modify the patient record in the database.

CO2: Create a HTML web page to show personal information.

CO3: Retrieve the information of a drug and its adverse effects using online tools.

CO4: Create mailing labels Using Label Wizard, generating label in MS WORD.

CO5: Create a database in MS Access to store the patient information and generate report and print the report from patient database.

CO6: Create invoice table and Export Tables, Queries, Forms and Reports to web pages and XML pages.

List of Laboratory Experiments

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

8.	Creating invoice table using – MS Access.
9.	Drug information storage and retrieval using MS Access.
10.	Creating and working with queries in MS Access.
11.	Exporting Tables, Queries, Forms and Reports to web pages.
12.	Exporting Tables, Queries, Forms and Reports to XML pages.

Learning Resources

Recommended Books (Latest Editions):

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.

JSPM University Pune First Year B. Pharmacy Semester- II		
Course Type: NA	**Course Title: ENVIRONMENTAL SCIENCES (Theory)**	
Course Code: BP206T	**Teaching Scheme: 3 Hrs./Week**	**Examination Scheme:**
Credits: 3	**Lecture (L): 3** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

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

Course Objectives: Upon completion of the course the student shall be able to**:**

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Create the awareness about environmental problems among learners.

CO2: Impart basic knowledge about the environment and its allied problems.

CO3: Develop an attitude of concern for the environment.

CO4: Motivate learner to participate in environment protection and environment improvement.

CO5: Acquire skills to help the concerned individuals in identifying and solving environmental problems.

CO6: Strive to attain harmony with Nature.

Course Contents

Unit I		**(10 Hrs)**
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.		
Unit II		**(10 Hrs)**
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)		
Unit III		**(10 Hrs)**
Environmental Pollution: Air pollution; Water pollution; Soil pollution		

Learning Resources

Recommended Books (Latest Editions):

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 – 380013, India.
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
5. Clark R.S., Marine Pollution, Clanderson Press Oxford.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p.
7. De A. K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment.

JSPM University Pune

Faculty of Health Sciences

School of Pharmaceutical Sciences

Pharmacy Council of India

New Delhi

Syllabus

for

Bachelor of Pharmacy (S. Y. B. Pharm) Course

(Effective from AY: 2025-26)

	JSPM University Pune	COURSE STRUCTURE (AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)	
	FACULTY OF HEALTH SCIENCES	W. E. F.	2025-2026
	SCHOOL OF PHARMACEUTICAL SCIENCES	RELEASE DATE	01/07/2025
SECOND YEAR BACHELOR OF PHARMACY		REVISION NO.	1.0 (PCI, New Delhi)

SEMESTER III

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS								TOTAL MARKS	CREDITS
			Hours/ Week				THEORY				PRACTICAL					
							INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)		
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL			
NA	BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP302T	Physical Pharmaceutics I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP303T	Pharmaceutical Microbiology – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP304T	Pharmaceutical Engineering – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP305P	Pharmaceutical Organic Chemistry II – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP306P	Physical Pharmaceutics I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP307P	Pharmaceutical Microbiology – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP308P	Pharmaceutical Engineering – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
Total			**12**	**4**	**16**	**-**	**40**	**60**	**100**	**300**	**20**	**40**	**60**	**140**	**600**	**24**
MLC#	BP309T	Laboratory Safety and Hazards Management	1	-	-	-	-	-	-	50	-	-	-	-	50	1

JSPM University Pune

FACULTY OF HEALTH SCIENCES

SCHOOL OF PHARMACEUTICAL SCIENCES

SECOND YEAR BACHELOR OF PHARMACY

COURSE STRUCTURE
(AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)

W. E. F.	**2024-2025**
RELEASE DATE	**01/07/2024**
REVISION NO.	**0.0 (PCI, New Delhi)**

SEMESTER IV

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS										TOTAL MARKS	CREDITS
			Hours/ Week				THEORY				PRACTICAL				ORAL (Equal Weightage for CIE and ESE)			
							INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	CONTINUOUS INSEMESTER EVALUATION (Marks)	END SEMESTER EXAMINATION (Marks)		
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL					
NA	BP401T	Pharmaceutical Organic Chemistry III – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP402T	Medicinal Chemistry I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP403T	Physical Pharmaceutics II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP404T	Pharmacology I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP405T	Pharmacognosy and Phytochemistry I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP406P	Medicinal Chemistry I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP407P	Physical Pharmaceutics II – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP408P	Pharmacology I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP409P	Pharmacognosy and Phytochemistry I - Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP410	Internship	4 to 6 Weeks				-	-	-	-	-	-	-	-	50	50	100	2
		Total	**15**	**5**	**16**	**-**	**50**	**75**	**125**	**375**	**20**	**40**	**60**	**140**	**50**	**50**	**800**	**30**
MLC#	230UPOB02_04	Introduction to Indian Constitution	1	-	-	-	-	-	-	50	-	-	-	-	-	-	50	1

JSPM University Pune Second Year B. Pharmacy Semester-III		
Course Type: NA	**Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY II (Theory)**	
Course Code: BP301T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.		
Course Objectives: Upon completion of the course the student shall be able to 1. Write the structure, name and the type of isomerism of the organic compound. 2. Write the reaction, name the reaction and orientation of reactions. 3. Account for reactivity/stability of compounds. 4. Prepare organic compounds.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Write down the chemical structures, names and types of isomerism in organic compounds. **CO2:** Write down the chemical reactions of organic compounds. **CO3:** Name the chemical reaction and orientation of reactions. **CO4:** Determine the reactivity and stability of organic compounds. **CO5:** Prepare the organic compounds. **CO6:** Write general methods of preparation, mechanism of reaction and applications of organic compounds.		

Course Contents

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be Explained. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

Unit I		**(10 Hrs)**

- **Benzene and its derivatives**

A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule

B. Reactions of benzene - nitration, sulphonation, halogenation reactivity, Friedel-crafts alkylation- reactivity, limitations, Friedel-crafts acylation.

C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction

D. Structure and uses of DDT, Saccharin, BHC and Chloramine

Unit II		**(10Hrs)**

- **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols
- **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts
- **Aromatic Acids* –**Acidity, effect of substituents on acidity and important reactions of benzoic acid.

Unit III		**(10 Hrs)**

- **Fats and Oils**

a. Fatty acids – reactions.

b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.

c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.

Unit IV		**(08 Hrs)**

- **Polynuclear hydrocarbons:**

a. Synthesis, reactions

b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

Unit V		**(07 Hrs)**

- **Cyclo alkanes***

Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY II (Practical)**	
Course Code: BP305P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Learn various laboratory techniques like recrystallization and steam distillation.

CO2: Determine the acid values of organic compounds.

CO3: Determine the saponification value of organic compounds.

CO4: Determine the iodine value of organic compounds.

CO5: Synthesize organic compounds and write mechanism of chemical reaction involved in it.

CO6: Perform characterization of organic compounds.

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

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

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- III		
Course Type: NA	**Course Title: PHYSICAL PHARMACEUTICS-I (Theory)**	
Course Code: BP302T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.		
Course Objectives: Upon the completion of the course student shall be able to 1. Understand various physicochemical properties of drug molecules in the designing the dosage forms. 2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations. 3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand various terminologies of solubility and describe mechanism & factors influencing solubility of drug.

CO2: Investigate and apply various theories, laws and equations related to different states of matter.

CO3: Explain physicochemical properties of drug in designing the dosage forms.

CO4: Distinguish the principles of complexation/ protein binding & to use them for calculations of drug release and stability constant.

CO5: Understand the Surface and interfacial phenomenon including the role of surface active agents

CO6: Gain the knowledge of pH, buffers and Isotonic solutions and its applications in pharmaceutical and biological systems.

Course Contents

Unit I		**(10 Hrs)**

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

Unit II		**(10Hrs)**

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

Unit III		**(10 Hrs)**

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

Unit IV		**(08 Hrs)**

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.		
Unit V		**(07 Hrs)**
pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.		

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHYSICAL PHARMACEUTICS-I (Practical)**	
Course Code: BP306P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Apply the knowledge of phase diagram to determine consolute temperatures.

CO2: Understand the concept of solubility and recognize basic rules and equations regarding physical principles.

CO3: Apply the knowledge of complexation and adsorption isotherms.

CO4: Understand the phenomenon of partition coefficient and surface tension.

CO5: Demonstrate use of physicochemical properties of drugs in the formulation development and evaluation of dosage forms.

CO6: Understand methods of determination of stability constant.

List of Laboratory Experiments	
1.	Determination the solubility of drug at room temperature
2.	Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3.	Determination of Partition co- efficient of benzoic acid in benzene and water
4.	Determination of Partition co- efficient of Iodine in CCl4 and water
5.	Determination of % composition of NaCl in a solution using phenol-water system by CST method
6.	Determination of surface tension of given liquids by drop count and drop weight method
7.	Determination of HLB number of a surfactant by saponification method
8.	Determination of Freundlich and Langmuir constants using activated charcoal
9.	Determination of critical micellar concentration of surfactants
10.	Determination of stability constant and donor acceptor ratio of PABA-Caffeine

	complex by solubility method
11.	Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Learning Resources

Recommended Books (Latest Editions):

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, 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.
8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Pharmacy, by Gaurav Jain & Roop K. Khar

JSPM University Pune Second Year B. Pharmacy Semester- III		
Course Type: NA	**Course Title: PHARMACEUTICAL MICROBIOLOGY (Theory)**	
Course Code: BP303T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: Study of all categories of microorganisims especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.		
Course Objectives: Upon the completion of the course student shall be able to 1. Understand methods of identification, cultivation and preservation of various microorganisms 2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry 3. Learn sterility testing of pharmaceutical products. 4. Carried out microbiological standardization of Pharmaceuticals. 5. Understand the cell culture technology and its applications in pharmaceutical industries.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Understand history and application of microbiology, types of microorganism and their morphology **CO2:** Understand methods of identification, cultivation and preservation of various microorganisms **CO3:** Understand the importance and implementation of sterilization in pharmaceutical processing and industry **CO4:** Learn sterility testing of pharmaceutical products **CO5:** Carried out microbiological standardization of Pharmaceuticals. **CO6:** Understand the cell culture technology and its applications in pharmaceutical Industries		

Course Contents		
Unit I		**(10 Hrs)**
Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy.		
Unit II		**(10Hrs)**
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. Equipment employed in large scale sterilization. Sterility indicators.		
Unit III		**(10 Hrs)**
Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.		
Unit IV		**(08 Hrs)**
Designing of aseptic area, laminar flow equipment; 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.		
Unit V		**(07 Hrs)**

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.

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL MICROBIOLOGY (Practical)**	
Course Code: BP307P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand working of Different equipment

CO2: Perform Isolation and Preservation of pure culture

CO3: Perform identification of bacteria by staining and biochemical tests

CO4: Perform Sterilization of glassware, preparation and sterilization of media

CO5: Perform sterility test

CO6: Perform Microbiological assay of antibiotics by cup plate method

List of Laboratory Experiments

1.	Introduction and study of different equipment and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2.	Sterilization of glassware, preparation and sterilization of media.
3.	Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4.	Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5.	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6.	Microbiological assay of antibiotics by cup plate method and other methods
7.	Motility determination by Hanging drop method.
8.	Sterility testing of pharmaceuticals.
9.	Bacteriological analysis of water
10.	Biochemical test.

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- III		
Course Type: NA	**Course Title: PHARMACEUTICAL ENGINEERING (Theory)**	
Course Code: BP304T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.		
Course Objectives: Upon the completion of the course student shall be able to 1. To know various unit operations used in pharmaceutical industries. 2. To understand the material handling techniques. 3. To perform various processes involved in pharmaceutical manufacturing process. 4. To carry out various test to prevent environmental pollution. 5. To appreciate and comprehend the significance of plant lay out design for optimum use of resources. 6. To appreciate the various preventive methods used for corrosion control in pharmaceutical industries.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the various unit operations used in Pharmaceutical industries.

CO2: Understand the material handling techniques.

CO3: Perform various processes involved in pharmaceutical manufacturing process.

CO4: Carry out various tests to prevent environmental pollution

CO5: Appreciate and comprehend significance of plant lay out design for optimum use of resources.

CO6: Appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course Contents

Unit I		**(10 Hrs)**

- **Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.
- **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.
- **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

Unit II		**(10Hrs)**

- **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.
- **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.
- **Distillation:** Basic Principles and methodology of simple distillation flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

Unit III		**(10 Hrs)**

- **Drying:** Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.
- **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

Unit IV		**(08 Hrs)**

- **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.
- **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

Unit V		**(07 Hrs)**

- **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACEUTICAL ENGINEERING (Practical)**	
Course Code: BP308P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the various unit operations used in Pharmaceutical industries.

CO2: Perform various processes involved in pharmaceutical manufacturing process.

CO3: Perform various processes involved in pharmaceutical manufacturing process.

CO4: Understand construction working and application of Pharmaceutical Machinery.

CO5: Understand the factors affecting Rate of Filtration and Evaporation.

CO6: Verify the laws of size reduction and perform the size analysis.

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

	Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
X.	Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
XI.	Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity
XII.	To study the effect of time on the Rate of Crystallization.
XIII.	To calculate the uniformity Index for given sample by using Double Cone Blender.

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- III		
Course Type: MLC#	**Course Title: LABORATORY SAFETY AND HAZARDS MANAGEMENT**	
Course Code: BP309T	**Teaching Scheme: 1 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L): 1** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

Scope: This audit course is designed to provide comprehensive knowledge and practical understanding of laboratory safety practices specifically tailored to pharmaceutical laboratory environments. It aims to equip students with the necessary skills, awareness, and ethical responsibilities to prevent and manage potential hazards associated with chemical, biological, physical, and ergonomic factors in the lab.

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

1. Introduce students to the fundamental principles of laboratory safety and the importance of hazard management in pharmaceutical settings.
2. Educate students on the safe handling, storage, and disposal of chemicals commonly used in pharmaceutical laboratories.
3. Provide knowledge on handling biological materials safely and preventing exposure to infectious agents
4. Address physical hazards and ergonomic practices to prevent injuries in the laboratory.
5. Educate on the principles and practices of managing hazardous waste in pharmaceutical laboratories.
6. Prepare to respond effectively to emergencies in the laboratory setting.
7. Instill a culture of safety and continuous improvement in laboratory practices.
8. Provide hands-on experience and real-world scenarios to reinforce safety concepts.

Course Outcomes: On completion of the course, learner will be able to

CO1: Identify and classify common laboratory hazards (chemical, biological, physical, and ergonomic) and explain their potential risks.

CO2: Interpret safety regulations, standards (OSHA, GHS), and demonstrate ethical responsibility in maintaining a safe lab environment.

CO3: Analyze and apply information from Material Safety Data Sheets (MSDS) to ensure safe chemical handling and emergency preparedness.

CO4: Demonstrate safe practices in waste management, including segregation, labeling, and disposal of hazardous pharmaceutical waste.

CO5: Execute appropriate emergency response and basic first aid procedures for laboratory incidents and accidents.

CO6: Promote a positive laboratory safety culture through regular audits, peer awareness, and adherence to best safety practices.

Course Contents		
Unit I	**Introduction to Laboratory Safety**	**(2 Hours)**

1. **Overview of Laboratory Safety** Importance of safety in pharmaceutical laboratories. Common laboratory hazards: chemical, biological, physical, and ergonomic.
2. **Legal and Ethical Considerations** Overview of relevant regulations and standards (e.g., OSHA, GHS, local safety laws). Ethical responsibilities of laboratory personnel.

Unit II	**Chemical, Biological, Physical and Ergonomic Safety**	**(5 Hours)**

1. **Chemical Hazards** Types of chemical hazards: corrosive, flammable, toxic, reactive. Routes of exposure: inhalation, ingestion, skin contact.
2. **Material Safety Data Sheets (MSDS)** Understanding and interpreting MSDS. Key sections: chemical properties, health hazards, first aid measures.
3. **Safe Handling Practices** Use of personal protective equipment (PPE). Proper labeling and storage of chemicals. Handling spills and accidents.
4. **Waste Disposal** Segregation and disposal of chemical waste. Regulatory guidelines for waste management
5. **Biological Hazards** Types of biological hazards: bacteria, viruses, fungi, prions. Risk assessment and containment levels.
6. **Biosafety Levels** Overview of biosafety levels (BSL-1 to BSL-4). Application in pharmaceutical research.
7. **Safe Practices** Use of biosafety cabinets. Proper handling and disposal of biological waste. Vaccination and health monitoring.
8. **Physical Hazards** Electrical safety: grounding, circuit protection. Fire safety: types of fires, fire extinguishers, emergency procedures. Mechanical hazards: equipment safety, lockout/tagout procedures.
9. **Ergonomic Practices** Proper workstation setup. Preventing repetitive strain injuries. Safe lifting techniques

Unit III	**Hazardous Waste Management**	**(2 Hours)**

1. **Types of Hazardous Waste** Chemical, biological, radioactive, and pharmaceutical waste.
2. **Waste Segregation and Labeling** Color-coded bins and labeling systems. Importance of accurate labeling for safety.
3. **Disposal Methods** Incineration, autoclaving, chemical neutralization. Regulatory requirements for disposal.

Unit IV	**Emergency Response and First Aid**	**(2 Hours)**

1. **Emergency Procedures** Evacuation plans and routes. Location and use of emergency equipment: eyewash stations, safety showers, fire extinguishers.
2. **First Aid Basics** CPR and basic life support. Treatment of chemical burns, cuts, and inhalation injuries.
3. **Reporting Incidents** Documentation and reporting procedures. Importance of incident analysis for prevention.

Unit V	**Laboratory Safety Culture and Best Practices**	**(2 Hours)**

1. **Safety Culture** Promoting safety awareness among peers. Encouraging reporting and addressing safety concerns.
2. **Best Practices** Regular safety audits and inspections. Continuous education and training. Staying updated with safety regulations and guidelines.

UNIT VI	Practical Demonstrations and Case Studies	(2 Hours)

1. **Practical Demonstrations** Proper use of PPE. Demonstration of fire extinguisher use. Handling and disposal of chemical spills.
2. **Case Studies** Analysis of past laboratory accidents. Discussion on causes, outcomes, and preventive measures.

Learning Resources

Recommended Books (Latest Editions):

1. Robert H. Hill Jr., David C. Finster "Laboratory Safety for Chemistry Students" Wiley A comprehensive guide tailored for students, covering all aspects of lab safety, including chemical hazards, PPE, emergency response, and waste disposal. For Unit I-V
2. National Research Council "Safe Science: Promoting a Culture of Safety in Academic Chemical Research" National Academies Press For UNIT V
3. U.S. Department of Health and Human Services (CDC/NIH) "Biosafety in Microbiological and Biomedical Laboratories (BMBL), 6th Edition" For Unit II
4. National Research Council "Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards" For Chemical hazards, waste disposal, emergency procedures
5. Frank R. Spellman "Occupational Safety and Health Simplified for the Chemical Industry" Bernan Press For Legal and regulatory aspects, OSHA, GHS (Unit I & III)
6. World Health Organization (WHO) "Laboratory Biosafety Manual" (4th edition) For Biological safety, biosafety cabinets, and containment practices (Unit II)

JSPM University Pune Second Year B. Pharmacy Semester- IV		
Course Type: NA	**Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY III (Theory)**	
Course Code: BP401T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.		
Course Objectives: Upon the completion of the course student shall be able to 1. understand the methods of preparation and properties of organic compounds. 2. explain the stereo chemical aspects of organic compounds and stereo chemical reactions. 3. know the medicinal uses and other applications of organic compounds.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Learn stereochemical aspects of organic compounds. **CO2:** Understand methods of preparation and properties of organic compounds. **CO3:** Understand mechanism of organic reactions. **CO4:** Know medicinal uses and applications of organic compounds. **CO5:** Understand nomenclature, reactions and synthesis of heterocyclic compounds. **CO6:** Know various reactions of synthetic importance and its mechanism.		
Course Contents		
Unit I		**(10 Hrs)**

Stereo isomerism

Optical isomerism

Optical activity, enantiomerism, diastereoisomerism, meso compounds, Elements of symmetry, chiral and achiral molecules

DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers

Reactions of chiral molecules, Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute

Unit II		**(10Hrs)**

Geometrical isomerism

Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems), Methods of determination of configuration of geometrical isomers.

Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.

Stereospecific and stereoselective reactions.

Unit III		**(10 Hrs)**

Heterocyclic compounds

Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrrole, Furan, and Thiophene, Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

Unit IV		**(08 Hrs)**

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

Unit V		**(07 Hrs)**

Reactions of synthetic importance

Metal hydride reduction (NaBH4 and LiAlH4),

Clemmensen reduction, Birch, reduction,

Wolff Kishner reduction, Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- IV		
Course Type: NA	**Course Title: MEDICINAL CHEMISTRY-I (Theory)**	
Course Code: BP402T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.		
Course Objectives: Upon the completion of the course student shall be able to 1. understand the chemistry of drugs with respect to their pharmacological activity 2. understand the drug metabolic pathways, adverse effect and therapeutic value of drugs 3. know the Structural Activity Relationship (SAR) of different class of drugs 4. write the chemical synthesis of some drugs		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Learn chemistry of medicinal compounds with respect to its pharmacological activity. **CO2:** Understand physicochemical properties of drugs in relation to biological action. **CO3:** Understand the classification and mechanism of action of drugs. **CO4:** Understand structure activity relationship of different class of drugs. **CO5:** Understand metabolic pathways, adverse effect and therapeutic value of drugs. **CO6:** Understand chemical synthesis of drugs.		

Course Contents

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

Unit I		**(10 Hrs)**

Introduction to Medicinal Chemistry

History and development of medicinal chemistry

Physicochemical properties in relation to biological action

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism

Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.

Unit II		**(10Hrs)**

Drugs acting on Autonomic Nervous System

Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution.

Sympathomimetic agents: SAR of Sympathomimetic agents

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

- Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.
- Agents with mixed mechanism: Ephedrine, Metaraminol.

Adrenergic Antagonists:

Alpha adrenergic blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

Unit III		**(10 Hrs)**

Cholinergic neurotransmitters

Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

Parasympathomimetic agents: SAR of Parasympathomimetic agents

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

Unit IV		**(08 Hrs)**

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturates: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital

Miscellaneous:

Amides & imides: Glutethmide.

Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol.

Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazines: SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Trifluprom azine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants**,** mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas**: Phenacemide, Carbamazepine* **Benzodiazepines**: Clonazepam **Miscellaneous:** Primidone, Valproic acid , Gabapentin, Felbamate

Unit V		**(07 Hrs)**

Drugs acting on Central Nervous System

General anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbiturates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine hydrochloride.*

Narcotic and non-narcotic analgesics

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: MEDICINAL CHEMISTRY-I (Practical)**	
Course Code: BP406P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Perform synthesis of medicinal compounds.

CO2: Understand chemical reactions involved in synthesis of compounds.

CO3: Understand mechanism of reaction involved in synthesis of compounds.

CO4: Perform characterization of synthesized medicinal compounds.

CO5: Perform assay of different medicinal compounds.

CO6: Determine the partition coefficient of drugs.

List of Laboratory Experiments	
I	**Preparation of drugs/ intermediates**
1	1,3-pyrazole
2	1,3-oxazole
3	Benzimidazole
4	Benztriazole
5	2,3- diphenyl quinoxaline
6	Benzocaine
7	Phenytoin
8	Phenothiazine
9	Barbiturate
II	**Assay of drugs**
1	Chlorpromazine
2	Phenobarbitone

3	Atropine
4	Ibuprofen
5	Aspirin
6	Furosemide
III	**Determination of Partition coefficient for any two drugs**

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

JSPM University Pune Second Year B. Pharmacy Semester- IV		
Course Type: NA	**Course Title: PHYSICAL PHARMACEUTICS-II (Theory)**	
Course Code: BP403T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.		
Course Objectives: Upon the completion of the course student shall be able to 1. Understand various physicochemical properties of drug molecules in the designing the dosage forms 2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations 3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.		

Course Outcomes: On completion of the course, learner will be able to

CO1: Explain the chemical and physical phenomena that govern the in vivo and in vitro actions of pharmaceutical products.

CO2: Demonstrate the understanding of different types of flow in order to identify and choose suitable flow characteristics for the formulation. Define reaction kinetics, reaction order, and discuss factors affecting the rate of the reaction. Describe the degradation and stabilization of medicinal agents as well as accelerated stability testing.

CO3: Demonstrate the skills and understanding of the principles, concepts of surface tension and its measurement.

CO4: Describe the physicochemical properties of drugs and assessment of physical stability; routes of degradation of drugs & principle methods of stabilization of Drugs.

CO5: Know the principles of chemical kinetics & to use them in assigning expiry date for Formulation

CO6: Explain the types, properties and applications of colloids in the formulations. Explain the properties of particles and pharmaceutical powders, their significance in formulating pharmaceutical products, and the common methods for characterizing these properties. Illustrate fundamentals and pharmaceutical applications of rheology.

Course Contents		
Unit I		**(05 Hrs)**
Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action.		
Unit II		**(10Hrs)**
Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers **Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus		
Unit III		**(10 Hrs)**

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.		
Unit IV		**(10 Hrs)**
Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.		
Unit V		**(10 Hrs)**
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		

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHYSICAL PHARMACEUTICS-II (Practical)**	
Course Code: BP407P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Predict surface tension of given liquid. Calculate Krafft point, Cloud point, critical micelle concentration and HLB value of given surfactant. Demonstrate the skills of working on Brookfield viscometer. Execute relative strength of two acids.

CO2: Calculate energy of activation of acid hydrolysis. Determine order of any reaction. Find out composition of binary mixture by viscosity method. Evaluate viscosity, specific surface area, particle size distribution & derived properties of any material.

CO3: Determination of particle size, particle size distribution using sieving method, How to Determine particle size, particle size distribution using Microscopic method and Determination of micromeritics properties of powders such as bulk density, true density, porosity and angle of repose.

CO4: Determine viscosity of liquid using Ostwald's viscometer, sedimentation volume with effect of different suspending agent

CO5: Determine sedimentation volume with effect of different concentration of single suspending agent and viscosity of semisolid by using Brookfield viscometer

CO6: Perform accelerated stability studies as per ICH guidelines for determining shelf life of dosage forms.

List of Laboratory Experiments	
1	Determination of particle size, particle size distribution using sieving method
2	Determination of particle size, particle size distribution using Microscopic method
3	Determination of bulk density, true density and porosity

4	Determine the angle of repose and influence of lubricant on angle of repose
5	Determination of viscosity of liquid using Ostwald's viscometer
6	Determination sedimentation volume with effect of different suspending agent
7	Determination sedimentation volume with effect of different concentration of single suspending agent
8	Determination of viscosity of semisolid by using Brookfield viscometer
9	Determination of reaction rate constant first order.
10	Determination of reaction rate constant second order
11	Accelerated stability studies

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- IV		
Course Type: NA	**Course Title: PHARMACOLOGY-I (Theory)**	
Course Code: BP404T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.		
Course Objectives: Upon the completion of the course student shall be able to 1. Understand the pharmacological actions of different categories of drugs 2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels. 3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases. 4. Observe the effect of drugs on animals by simulated experiments 5. Appreciate correlation of pharmacology with other bio medical sciences		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the fundamental pharmacological concepts and mechanisms, including drug administration routes, agonists, antagonists, addiction, and tolerance.

CO2: Analyze drug actions, adverse reactions, interactions, and the drug discovery process, integrating knowledge of pharmacokinetics and pharmacodynamics.

CO3: Differentiate drug classes affecting the peripheral nervous system and comprehend their clinical applications.

CO4: Understand neurohumoral transmission in the CNS and analyze the mechanisms and clinical uses of various class of drugs.

CO5: Evaluate the pharmacological properties of psychopharmacological agents, including antipsychotics, antidepressants, and CNS stimulants, and understand their therapeutic applications.

CO6: Integrate knowledge of pharmacodynamics and pharmacokinetics to analyze the therapeutic effects and adverse reactions of drugs used in neurological disorders, pain management, and addiction treatment.

Course Contents

Unit I		**(08 Hrs)**

General Pharmacology

a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non-competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.

b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination

Unit II		**(12 Hrs)**

General Pharmacology

a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.

b. Adverse drug reactions.

c. Drug interactions (pharmacokinetic and pharmacodynamic)

d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

Unit III		**(10 Hrs)**

Pharmacology of drugs acting on peripheral nervous system

a. Organization and function of ANS.

b. Neurohumoral transmission,co-transmission and classification of neurotransmitters.

c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

Unit IV		**(08 Hrs)**

Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the CNS special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.

b. General anesthetics and pre-anesthetics**.**

c. Sedatives, hypnotics and centrally acting muscle relaxants.

d. Anti-epileptics

e. Alcohols and disulfiram

Unit V		**(07 Hrs)**

Pharmacology of drugs acting on central nervous system

a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.

b. Drugs used in Parkinsons disease and Alzheimer's disease.

c. CNS stimulants and nootropics.

d. Opioid analgesics and antagonists

e. Drug addiction, drug abuse, tolerance and dependence.

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACOLOGY-I (Practical)**	
Course Code: BP408P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Apply principles of experimental pharmacology to design and conduct laboratory experiments effectively.

CO2: Demonstrate proficiency in utilizing a variety of instruments commonly employed in experimental pharmacology research.

CO3: Comprehend skills in the ethical handling and maintenance of laboratory animals according to CPCSEA guidelines.

CO4: Learn essential laboratory techniques, including blood withdrawal, serum and plasma separation, and the administration of anesthetics and euthanasia for animal studies.

CO5: Analyze drug-receptor interactions and dose-response relationships.

CO6: Evaluate pharmacokinetic and pharmacodynamic drug interactions and preclinical drug evaluations.

List of Laboratory Experiments	
1	Introduction to experimental pharmacology.
2	Commonly used instruments in experimental pharmacology.
3	Study of common laboratory animals.
4	Maintenance of laboratory animals as per CPCSEA guidelines.
5	Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6	Study of different routes of drugs administration in mice/rats.
7	Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8	Effect of drugs on ciliary motility of frog oesophagus

9	Effect of drugs on rabbit eye.
10	Effects of skeletal muscle relaxants using rota-rod apparatus.
11	Effect of drugs on locomotor activity using actophotometer.
12	Anticonvulsant effect of drugs by MES and PTZ method.
13	Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14	Study of anxiolytic activity of drugs using rats/mice.
15	Study of local anesthetics by different methods
	Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Learning Resources

Recommended Books (Latest Editions):

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

JSPM University Pune Second Year B. Pharmacy Semester- IV		
Course Type: NA	**Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)**	
Course Code: BP405T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 75 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.		
Course Objectives: Upon the completion of the course student shall be able to 1. to know the techniques in the cultivation and production of crude drugs 2. to know the crude drugs, their uses and chemical nature 3. know the evaluation techniques for the herbal drugs 4. to carry out the microscopic and morphological evaluation of crude drugs		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Learn the scope of pharmacognosy and classification of crude drugs **CO2:** Know the techniques in the cultivation and production of crude drugs **CO3:** Know the different crude drugs, their uses and chemical nature **CO4:** Know the concept, application of PTC and introduction to primary and secondary metabolites **CO5:** Know the evaluation techniques for the herbal drugs **CO6:** Carry out the microscopic and morphological evaluation of crude drugs		
Course Contents		
Unit I		**(10 Hrs)**

Introduction to Pharmacognosy:

(a) Definition, history, scope and development of Pharmacognosy

(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture

(c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, 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.

Unit II		**(10 Hrs)**

Cultivation, Collection, Processing and storage of drugs of natural origin:

Cultivation and Collection of drugs of natural origin

Factors influencing cultivation of medicinal plants.

Plant hormones and their applications.

Polyploidy, mutation and hybridization with reference to medicinal plants

Conservation of medicinal plants

Unit III		**(07 Hrs)**

Plant tissue culture:

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.

Applications of plant tissue culture in pharmacognosy.

Edible vaccines

Unit IV		**(10 Hrs)**

Pharmacognosy in various systems of medicine:

Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites:

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

Unit V		(08 Hrs)

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

Plant Products:

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural allergens

Primary metabolites:

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes: Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids (Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs: Novel medicinal agents from marine sources

JSPM University Pune Second Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)**	
Course Code: BP409P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Study different chemical test for primary metabolites

CO2: Study different chemical test for secondary metabolites

CO3: Know the different microscopic evaluation parameters of crude drugs

CO4: Know the determination of different quantitative evaluation parameters of crude drugs

CO5: Study physical evaluation parameters of crude drugs

CO6: Study applications of different evaluation parameters of crude drugs

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

Learning Resources

Recommended Books (Latest Editions):

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

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

3. Text Book of Pharmacognosy by T.E. Wallis

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

5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (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. S H. Ansari, IInd edition, Birla publications, New Delhi, 2007

8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhale

9. Anatomy of Crude Drugs by M.A. Iyengar

JSPM University Pune

Semester- IV

Course Type: MLC	**Course Title:** Introduction to Indian Constitution	
Course Code: 230UPOB02_04	**Teaching Scheme:** (Hrs./Week)	**Examination Scheme:**
Credits: 1	**Lecture (L):** 1 **Tutorial (T):** 0 **Practical (P):** 0 **Experiential Learning (EL):** 0	**Theory (TH):** 50 Marks

Prerequisite Courses, if any: Nil

Course Objectives:

- To understand the historical context and constitutional development of India, including the impact of the colonial legacy and the role of the Constituent Assembly.
- To analyse the core principles of the Indian Constitution, including the Preamble, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, and their interrelationships.
- To examine the structure of the Indian government, the process of constitutional amendments, and the role of judicial review in upholding constitutional principles.

Course Outcomes: On completion of the course, learner will be able to

CO1: Remember- Recall the historical background, key events, and figures involved in the constitutional development of India.

CO2: Understand- Explain the significance of the Preamble and the fundamental principles of the Indian Constitution, such as sovereignty, secularism, socialism, and democracy.

CO3: Apply- Demonstrate an understanding of Fundamental Rights and Duties by identifying their applications and limitations in real-world scenarios.

CO4: Analyse- Analyse the relationship between Fundamental Rights and Directive Principles of State Policy, and how they interact to shape governance in India.

CO5: Evaluate- Assess the effectiveness of significant constitutional amendments and the role of judicial review in maintaining the integrity of the Indian Constitution.

CO6: Create- Develop a coherent argument or proposal for a constitutional amendment or policy change, grounded in the principles and structure of the Indian Constitution.

Course Contents

Unit I	**Historical background**	**(3 Hrs)**
Colonial legacy, Constitutional development, The constituent assembly		
Unit II	**Preamble and fundamental principles**	**(2 Hrs)**
The Preamble, Sovereignty, Secularism, Socialism, and Democracy, Justice, Liberty, Equality, and Fraternity		
Unit III	**Fundamental Rights and Duties**	**(3 Hrs)**
Fundamental rights, Fundamental duties, Restrictions and amendments		
Unit IV	**Directive Principles of State Policy**	**(3 Hrs)**
Definition and purpose, Classification, Relationship with fundamental rights		
Unit V	**Organs of the Government**	**(2 Hrs)**
Union and state governments, The President and Prime minister, Parliamentary system		
Unit VI	**Amendments and Judicial Review**	**(2 Hrs)**
Amendment process, Significant amendments, Judicial review		

Learning Resources

Textbooks:

1. Basu, D. D., *Introduction to Constitution of India*, Prentice Hall of India, 1989
2. M. P. Jain, Indian Constitutional Law, LexisNexis, 2020

Reference Books:

1. Granville Austin The Indian Constitution: Cornerstone of a Nation, Oxford University Press, 1966
2. Mahendra Pal Singh, Shukla's Constitution of India, Eastern Book Company, 2019
3. Rajani Goyal, Modern Constitutions, RBSA Publications, 2023
4. Sukhbir Bhatnagar, Constitutional Law and the Governance, Mittal Publications, 2008

MOOC / NPTEL Courses:

1. Swayam: Constitutional Law **Link of the Course:** Constitutional Law, Aneeda Jan

Additional Web Resources: Constitution of India

JSPM University Pune

Faculty of Health Sciences

School of Pharmaceutical Sciences

Pharmacy Council of India

New Delhi

Syllabus

for

Bachelor of Pharmacy (T. Y. B. Pharm) Course

(Effective from AY: 2025-26)

JSPM University Pune

FACULTY OF HEALTH SCIENCES	W. E. F.	2025-2026
SCHOOL OF PHARMACEUTICAL SCIENCES	RELEASE DATE	01/07/2025
THIRD YEAR BACHELOR OF PHARMACY	REVISION NO.	0.0 (PCI, New Delhi)

COURSE STRUCTURE
(AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)

SEMESTER V

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS								TOTAL MARKS	CREDITS
			Hours/ Week				THEORY				PRACTICAL					
TYPE	CODE	COURSE NAME	L	T	P	EL	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)		
							CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL			
NA	BP501T	Medicinal Chemistry II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP502T	Industrial Pharmacy I – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP503T	Pharmacology II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP504T	Pharmacognosy and Phytochemistry II – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP505T	Pharmaceutical Jurisprudence – Theory	3	1	-	-	10	15	25	75	-	-	-	-	100	4
NA	BP506P	Industrial Pharmacy I – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP507P	Pharmacology II – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
NA	BP508P	Pharmacognosy and Phytochemistry II – Practical	-	-	4	-	-	-	-	-	5	10	15	35	50	2
Total			**15**	**5**	**12**	**-**	**50**	**75**	**125**	**375**	**15**	**30**	**45**	**105**	**650**	**26**
MLC#	250HPSB02_05	Nutraceuticals and Functional Foods	1	-	-	-	-	-	-	50	-	-	-	-	50	**1**

JSPM University Pune

FACULTY OF HEALTH SCIENCES		W. E. F.	2025-2026
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COURSE STRUCTURE
(AS PER RULES AND REGULATIONS OF PHARMACY COUNCIL OF INDIA, NEW DELHI)

SEMESTER VI

COURSE			TEACHING SCHEME				EXAMINATION SCHEME AND MARKS										TOTAL MARKS	CREDITS
			Hours/ Week				THEORY				PRACTICAL				ORAL (Equal Weightage for CIE and ESE)			
							INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	INTERNAL ASSESSMENT (Marks)			END SEMESTER EXAMINATION (Marks)	CONTINUOUS INSEMESTER EVALUATION (Marks)	END SEMESTER EXAMINATION (Marks)		
TYPE	CODE	COURSE NAME	L	T	P	EL	CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL		CONTINUOUS MODE	SESSIONAL EXAMS	TOTAL					
NA	BP601T	Medicinal Chemistry III – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP602T	Pharmacology III – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP603T	Herbal Drug Technology –Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP605T	Pharmaceutical Biotechnology – Theory	3	1	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP606T	Quality Assurance– Theory	3	**1**	-	-	10	15	25	75	-	-	-	-	-	-	100	4
NA	BP607P	Medicinal chemistry III – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP608P	Pharmacology III – Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP609P	Herbal Drug Technology –Practical	-	-	4	-	-	-	-	-	5	10	15	35	-	-	50	2
NA	BP611	Internship	4 to 6 Weeks				-	-	-	-	-	-	-	-	**50**	**50**	100	2
Total			**18**	**6**	**12**	**-**	**60**	**90**	**150**	**450**	**15**	**30**	**45**	**105**	**50**	**50**	**850**	**32**
MLC #	BP610T	Basics of Disaster Management	1	-	-	-	-	-	-	50	-	-	-	-	-	-	50	**1**

JSPM University Pune

Third Year B. Pharmacy

Semester- V

Course Type: NA	**Course Title: MEDICINAL CHEMISTRY – II (Theory)**	
Course Code: BP501T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

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

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the chemistry and influence of metabolic profile of different category of drugs and their impact on biological system

CO2: Study definition, classification of different category of drugs

CO3: Know the mechanism of action of different category of drugs

CO4: Understand therapeutic uses, adverse effects, toxic effects of different category of drugs

CO5: Acquire knowledge about the relationship between Structure activity of drugs(SAR) and biological activity.

CO6: Study synthetic strategy of selected drugs.

Course Contents

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

Unit I	Title of Unit	(10 Hours)

Antihistaminic agents: Histamine, receptors and their distribution in the human body

H1–antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium

H2-antagonists: Cimetidine*, Famotidine, Ranitidin.

Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

Anti-neoplastic agents: Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa

Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine

Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin

Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate

Miscellaneous: Cisplatin, Mitotane.

Unit II		**(10 Hours)**

Anti-anginal: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole.

Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics: Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol

Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide,Minoxidil, Reserpine, Hydralazine hydrochloride.

Unit III		**(10 Hours)**

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemic agents**:

Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants**: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel **Drugs used in Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

Unit IV		**(8 Hours)**

Drugs acting on Endocrine system

Nomenclature, Stereochemistry and metabolism of steroids

Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for erectile dysfunction**: Sildenafil, Tadalafil.

Oral contraceptives: Mifepristone, Norgestril, Levonorgestrol

Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone

Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

Unit V		**(7 Hours)**

Antidiabetic agents: Insulin and its preparations Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose.

Local Anesthetics: SAR of Local anesthetics

Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.

Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.

Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

Miscellaneous: Phenacaine, Diperodon, Dibucaine.*

Learning Resources

Recommended Books (Latest Editions)

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

JSPM University Pune Third Year B. Pharmacy Semester- V		
Course Type: NA	**Course Title: INDUSTRIAL PHARMACY I (THEORY)**	
Course Code: BP502T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.		
Course Objectives: Upon completion of the course the student shall be able to 1. Know the various pharmaceutical dosage forms and their manufacturing techniques. 2. Know various considerations in development of pharmaceutical dosage forms 3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Explain the general considerations and procedures involved in pilot plant scale-up of pharmaceutical dosage forms. **CO2:** Describe and apply the principles and process of technology transfer from laboratory to production scale. **CO3:** Identify and discuss the roles and responsibilities of regulatory bodies and professionals in the pharmaceutical industry. **CO4:** Summarize the drug development process and interpret the regulatory requirements for Investigational New Drug (IND) and New Drug Application (NDA) submissions. **CO5:** Explain and evaluate quality management systems and certifications used in the pharmaceutical industry **CO6:** Outline the Indian regulatory framework and approval processes for new drugs under CDSCO and state licensing authorities.		
Course Contents		
Unit I	**Title of Unit**	**(7 Hours)**

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

Unit II		**(10 Hours)**

Tablets:

a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

Unit III		**(8 Hours)**

Capsules:

a. ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. ***Soft gelatin capsules:*** Nature of shell and capsule content, size of capsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

Unit IV		**(10 Hours)**

Parenteral Products:

a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity

b. Production procedure, production facilities and controls, aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

Unit V		**(10 Hours)**

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.

JSPM UNIVERSITY PUNE
Recognized by UGC u/s 2 (f) of UGC Act 1956 and enacted by the
State Government of Maharashtra - JSPM University Act, 2022 (Mah.IV of 2023)

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **INDUSTRIAL PHARMACY I (PRACTICAL)**	
Course Code: BP506P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50** **Marks Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand and perform preformulation parameters like solubility, partition coefficient, melting point, flow properties, and compatibility studies for drugs

CO2: Gain hands-on experience in the preparation and evaluation of tablets (e.g., Paracetamol and Aspirin) and capsules (e.g., Tetracycline), including parameters like weight variation, disintegration, hardness, friability, and dissolution.

CO3: Learn the aseptic preparation and quality evaluation of injectable formulations like Calcium Gluconate and Ascorbic Acid, focusing on sterility, pyrogen testing, and isotonicity.

CO4: Formulate and evaluate creams (cold/vanishing), eye drops, and eye ointments, understanding the specific requirements for ophthalmic and topical products.

CO5: Perform film coating of tablets or granules and understand the purpose, materials used, and evaluation of coated dosage forms.

CO6: Conduct quality control tests on marketed tablets, capsules, and glass containers as per IP standards, ensuring compliance with regulatory requirements.

List of Laboratory Experiments

1.	Preformulation studies on paracetamol/aspirin/or any other drug
2.	Preparation and evaluation of Paracetamol tablets
3.	Preparation and evaluation of Aspirin tablets
4.	Coating of tablets- film coating of tables/granules
5.	Preparation and evaluation of Tetracycline capsules
6.	Preparation of Calcium Gluconate injection
7.	Preparation of Ascorbic Acid injection

8.	Quality control test of (as per IP) marketed tablets and capsules
9.	Preparation of Eye drops/ and Eye ointments
10.	Preparation of Creams (cold / vanishing cream)
11.	Evaluation of Glass containers (as per IP)

Learning Resources

Recommended Books: (Latest Editions)

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

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

3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman

4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition

5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)

6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman

7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition

8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5thedition, 2005

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

JSPM University Pune Third Year B. Pharmacy Semester- V		
Course Type: NA	**Course Title: PHARMACOLOGY-II (THEORY)**	
Course Code: BP503T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.		
Course Objectives: Upon completion of this course the student should be able to 1. Understand the mechanism of drug action and its relevance in the treatment of different diseases 2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments 3. Demonstrate the various receptor actions using isolated tissue preparation 4. Appreciate correlation of pharmacology with related medical sciences		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Describe the pharmacology of cardiovascular drugs (mechanisms, ADR, uses) and defend appropriate first-line therapy choices for hypertension with comorbidities **CO2**: Examine the mechanisms of diuretics/antidiuretics and relate their use to patient-centered care (e.g., renal/hepatic impairment). **CO3:** Discuss Pharmacology of drugs used in heamatological diseases. Summarize the roles of autocoids in inflammation and integrate therapeutic drug monitoring principles for NSAID safety. **CO4:** Explain the mechanisms of endocrine drugs (e.g., insulin, corticosteroids) and discuss their risk-benefit ratios in polypharmacy.		

CO5: Interpret the pharmacology of sex hormones (androgen, anabolic steroids, etc) and recognize pharmacovigilance requirements for hormone therapy.

CO6: Evaluate bioassay methods for drug potency and advocate for Good Laboratory Practices (GLP) in pharmacological research.

Course Contents

Unit I	**Title of Unit**	**(10 Hours)**

1. Pharmacology of drugs acting on cardio vascular system

a. Introduction to hemodynamic and electrophysiology of heart.

b. Drugs used in congestive heart failure

c. Anti-hypertensive drugs.

d. Anti-anginal drugs.

e. Anti-arrhythmic drugs.

f. Anti-hyperlipidemic drugs.

Unit II		**(10 Hours)**

1. Pharmacology of drugs acting on cardio vascular system

a. Drug used in the therapy of shock.

b. Hematinics, coagulants and anticoagulants.

c. Fibrinolytics and anti-platelet drugs

d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

a. Diuretics

b. Anti-diuretics.

Unit III		**(10 Hours)**

3. Autocoids and related drugs

a. Introduction to autacoids and classification

b. Histamine, 5-HT and their antagonists.

c. Prostaglandins, Thromboxanes and Leukotrienes.

d. Angiotensin, Bradykinin and Substance P.

e. Non-steroidal anti-inflammatory agents

f. Anti-gout drugs

g. Antirheumatic drugs

Unit IV		**(8 Hours)**

5. Pharmacology of drugs acting on endocrine system

a. Basic concepts in endocrine pharmacology.

b. Anterior Pituitary hormones- analogues and their inhibitors.

c. Thyroid hormones- analogues and their inhibitors.

d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.

d. Insulin, Oral Hypoglycemic agents and glucagon.

e. ACTH and corticosteroids.

Unit V		**(7 Hours)**

5. Pharmacology of drugs acting on endocrine system

a. Androgens and Anabolic steroids.

b. Estrogens, progesterone and oral contraceptives.

c. Drugs acting on the uterus.

6. Bioassay

a. Principles and applications of bioassay.

b. Types of bioassay

c. Bioassay of insulin, oxytocin, vasopressin, ACTH, -tubocurarine, digitalis, histamine and 5-HT

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **PHARMACOLOGY-II (PRACTICAL)**	
Course Code: BP507P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50** **Marks Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Analyze drug-induced changes in isolated tissue preparations (frog heart, rat ileum) and calibrate instruments for accurate physiological measurements.

CO2: Compare dose-response relationships of agents acting on cholinergic pathway (Physostigmine, Atropine, ACh, histamine) and demonstrate aseptic techniques for in vitro bioassays.

CO3: Evaluate bioassay data (oxytocin, serotonin) using statistical methods and execute organ bath experiments with precision.

CO4: Interpret PA2/PD2 values (Schild plot) for receptor antagonism and assemble experimental setups for in vivo models (anti-inflammatory, analgesia).

CO5: Demonstrate the effect of spasmogens and spasmolytics using rabbit jejunum and discuss its pharmacological interventions.

CO6: Administer drug to analyze anti-inflammatory and analgesic activity in paw edema and central model.

List of Laboratory Experiments	
1.	Introduction to *in-vitro* pharmacology and physiological salt solutions.
2.	Effect of drugs on isolated frog heart.
3.	Effect of drugs on blood pressure and heart rate of dog.
4.	Study of diuretic activity of drugs using rats/mice.
5.	DRC of acetylcholine using frog rectus abdominis muscle.
6.	Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.

7.	Bioassay of histamine using guinea pig ileum by matching method.
8.	Bioassay of oxytocin using rat uterine horn by interpolation method.
9.	Bioassay of serotonin using rat fundus strip by three point bioassay.
10.	Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11.	Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12.	Determination of PD2 value using guinea pig ileum.
13.	Effect of spasmogens and spasmolytics using rabbit jejunum.
14.	Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15.	Analgesic activity of drug using central and peripheral methods
	Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Learning Resources

Recommended Books: (Latest Editions)

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

JSPM University Pune Third Year B. Pharmacy Semester- V		
Course Type: NA	**Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY II (THEORY)**	
Course Code: BP504T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

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

Course Objectives: Upon completion of the course, the student shall be able

1. to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. to understand the preparation and development of herbal formulation.
3. to understand the herbal drug interactions
4. to carryout isolation and identification of phytoconstituents

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the metabolic pathways in higher plants and their role in the biosynthesis of secondary metabolites.

CO2: Analyze the formation, sources, and importance of various secondary metabolites like alkaloids, flavonoids, etc.

CO3: Demonstrate the techniques for isolation, identification, and analysis of key phytoconstituents.

CO4: Evaluate industrial methods for large-scale production, estimation, and application of major phytoconstituents.

CO5: Apply advanced extraction, purification, and identification techniques in phytochemical studies.

CO6: Interpret the significance of phytochemical techniques in standardizing herbal drugs for pharmaceutical use.

Course Contents

Unit I	**Title of Unit**	**(7 Hours)**

Metabolic pathways in higher plants and their determination

a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.

b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

Unit II		**(14 Hours)**

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta **Steroids, Cardiac Glycosides & Triterpenoids**: Liquorice, Dioscorea, Digitalis **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, **Tannins:** Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides:** Senna, Aloes, Bitter Almond

Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

Unit III		**(6 Hours)**

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrhetinic acid & Rutin

c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine

d) Resins: Podophyllotoxin, Curcumin

Unit IV		**(10 Hours)**

Industrial production, estimation and utilization of the following phytoconstituents:

Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

Unit V		**(8 Hours)**

Basics of Phytochemistry

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY II (PRACTICAL)**	
Course Code: BP508P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50** **Marks Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Demonstrate morphological, histological, and powder characteristics of plants, and perform extraction and detection of phytoconstituents

CO2: Isolate and identify active principles from plant materials

CO3: Separate sugars by paper chromatography.

CO4: Perform TLC of herbal extracts.

CO5: Distill volatile oils and analyze phytoconstituents by TLC

CO6: Conduct chemical tests for crude drugs

List of Laboratory Experiments

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

Learning Resources

Recommended Books: (Latest Editions)

1. W. C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

JSPM University Pune Third Year B. Pharmacy Semester- V		
Course Type: NA	**Course Title:** **PHARMACEUTICAL JURISPRUDENCE (THEORY)**	
Course Code: BP505T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.		
Course Objectives: Upon completion of the course, the student shall be able to understand: 1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals. 2. Various Indian pharmaceutical Acts and Laws 3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals 4. The code of ethics during the pharmaceutical practice		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Understand the pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals. **CO2**: Study the various Indian pharmaceutical Acts and Laws governing the profession and practice of pharmacy. **CO3:** Learn about the regulatory authorities and agencies governing the manufacture, import, export, and sale of pharmaceuticals. **CO4:** Understand the code of ethics and professional conduct during pharmaceutical practice. **CO5:** Understand the intellectual property rights (IPR) **CO6:** Understand contemporary legal provisions related to innovation and protection in the pharmaceutical field.		
Course Contents		

Unit I	Title of Unit	(10 Hours)

Drugs and Cosmetics Act, 1940 and its rules 1945:

Objectives, Definitions, Legal definitions of schedules to the Act and Rules

Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.**

Manufacture of drugs – Prohibition of manufacture and sale of certain drugs,

Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

Unit II		(14 Hours)

Drugs and Cosmetics Act, 1940 and its rules 1945.

Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties

Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

Unit III		(10 Hours)

- **Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties
- **Medicinal and Toilet Preparation Act –1955**: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.
- **Narcotic Drugs and Psychotropic substances Act-1985 and Rules**: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

Unit IV		(8 Hours)

- **Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties
- **Prevention of Cruelty to animals Act-1960:** Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties
- **National Pharmaceutical Pricing Authority:** Drugs Price Control Order (DPCO)-2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

Unit V		**(7 Hours)**

- **Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee
- **Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath
- **Medical Termination of Pregnancy Act**
- **Right to Information Act**
- **Introduction to Intellectual Property Rights (IPR)**

Learning Resources

Recommended Books: (Latest Editions)

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)

JSPM University Pune

Third Year B. Pharmacy

Semester- V

Course Type: MLC#	**Course Title: Nutraceuticals and Functional Foods**	
Course Code: 250HPSB02_05	**Teaching Scheme: 1 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L): 1** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

1. Provide students with comprehensive knowledge of nutraceuticals and functional foods, focusing on their definitions, classifications, sources, and health benefits.
2. Develop an understanding of their role in disease prevention and management, explore the scientific principles behind functional food development, and examine key bioactive compounds such as antioxidants and phytochemicals.
3. Introduce the concepts of prebiotics and probiotics and address current marketing trends and regulatory frameworks including guidelines from CODEX, the European Union (EU), and the Food Safety and Standards Authority of India (FSSAI).

Course Outcomes: On completion of the course, learner will be able to

CO1: Define and classify nutraceuticals and functional foods based on their chemical, biochemical sources, and understand their scope and future applications.

CO2: Describe the principles of functional food science and food technology and evaluate their role in the development of functional foods.

CO3: Identify nutraceuticals and functional foods used in the management of major diseases such as cardiovascular diseases, diabetes, cancer, and obesity.

CO4: Explain the concept of free radicals and antioxidants and assess the role of antioxidants as nutraceuticals and functional foods.

CO5: Recognize various phytochemicals (phytosterols, carotenoids, polyphenols, flavonoids, saponins), their classifications, sources, and applications in functional foods.

CO6: Describe the types, health benefits, and synergistic effects of prebiotics, probiotics, and symbiotics in human health.

CO7: Analyze the marketing and regulatory framework for nutraceuticals and functional foods, with reference to CODEX, EU, and FSSAI guidelines.		
Course Contents		
Unit I	**Nutraceuticals and Functional Foods**	**(3 Hours)**
Definition, Classification-chemical/biochemical, Source, Used, Scope and Future. Functional food science, Food technology, Its impact on functional food development.		
Unit II	**Nutraceutical and functional food for disease management**	**(3 Hours)**
Cardiovascular diseases, Diabetes, Cancer, Obesity.		
Unit III	**Antioxidants**	**(2 Hours)**
Concept of free radicals and antioxidants, Antioxidants role as nutraceuticals and functional foods.		
Unit IV	**Phytochemicals**	**(3 Hours)**
Phytosterols, Carotenoids, Polyphenols, Flavonoids, Saponins- Classification, Sources, Their uses as nutraceuticals in functional foods.		
Unit V	**Pre and Pro Biotics**	**(2 Hours)**
Types, Health Benefits, Concept of symbiotic.		
Unit VI	**Marketing and regulatory issues for nutraceuticals and functional foods**	**(2 Hours)**
CODEX Guidelines, EU Guidelines, FSSAI Guidelines		

Learning Resources

Textbooks:

1. **Wildman, R. E. C. (Ed.)** *Handbook of Nutraceuticals and Functional Foods* CRC Press, 2nd Edition, 2006. ISBN: 9780849396794 – A comprehensive reference covering fundamental concepts, classifications, and applications of nutraceuticals and functional foods.
2. **Gibson, G. R., and Williams, C. M.** *Functional Foods: Concept to Product* Woodhead Publishing, 2000. ISBN: 9781855735039 – Discusses the science, development, and marketing of functional foods.

Reference Books:

1. **Murray, M. T.** *The Encyclopedia of Nutritional Supplements* Prima Publishing, 1996. ISBN: 9780761511573 – A practical reference guide covering a wide range of dietary supplements and their uses in health and disease prevention.
2. **Manson, J. E., & Stampfer, M. J.** *Functional Foods: Cardiovascular Disease and Diabetes* Wiley-Blackwell, 2006. ISBN: 9780917678497 – Provides insights into the role of functional foods in the management of cardiovascular disease and diabetes.
3. **Smith, J., & Charter, E. (Eds.)** *Functional Food Product Development* Wiley-Blackwell, 2010. ISBN: 9781405169333 – Focuses on product development processes, formulation, and innovation in functional food design.
4. **Remacle, C., & Reusens, B. (Eds.)** *Functional Foods, Ageing and Degenerative Disease* Woodhead Publishing, 2004. ISBN: 9781855737255 – Addresses the potential of functional foods in managing ageing-related degenerative diseases.
5. **Shahidi, F.** *Nutraceuticals and Functional Foods in Human Health and Disease Prevention* CRC Press, 2015. ISBN: 9781466566283 – Combines theoretical and applied aspects of nutraceuticals with human health and disease prevention focus.

MOOC Course: Functional Foods and Nutraceuticals – SWAYAM (India)

https://onlinecourses.swayam2.ac.in/cec21_ag07/preview?utm_source

JSPM University Pune

Third Year B. Pharmacy

Semester- VI

Course Type: NA	**Course Title: MEDICINAL CHEMISTRY – III (THEORY)**	
Course Code: BP601T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

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

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand the chemistry of drugs with respect to their biological activity

CO2: Recognize about the metabolism, adverse effects and therapeutic value of drugs.

CO3: Know the importance of Structural Activity Relationship of drugs

CO4: Learn the synthetic routes of drugs

CO5: Understand the importance of drug design and different techniques of drug design

CO6: Understand the physicochemical properties of drug

Course Contents

Unit I		**(10 Hours)**

Antibiotics Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

Unit II		**(10 Hours)**

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine,

Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone.

Unit III		**(10 Hours)**

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate. **Urinary tract anti-infective agents**

Quinolones: SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine. **Antiviral agents:**

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

Unit IV		**(8 Hours)**

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

Unit V		**(7 Hours)**

Introduction to Drug Design

Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **MEDICINAL CHEMISTRY- III (PRACTICAL)**	
Course Code: BP607P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50** **Marks Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Perform synthesis of drugs and drug intermediate

CO2: Perform assay of drugs

CO3: Design structures and reactions using Chem draw

CO4: Illustrate mechanism related to synthesis of drug

CO5: Interpret physicochemical properties using drug design software

CO6: Develop correlation of synthesized drugs with physicochemical properties

List of Laboratory Experiments	
I	**Preparation of drugs and intermediates**
1	Sulphanilamide
2	7-Hydroxy, 4-Methyl Coumarin
3	Chlorobutanol
4	Triphenyl Imidazole
5	Tolbutamide
6	Hexamine
II	**Assay of drugs**
1	Isonicotinic acid hydrazide
2	Chloroquine
3	Metronidazole
4	Dapsone
5	Chlorpheniramine maleate
6	Benzyl penicillin

III	Preparation of medicinally important compounds or intermediates by Microwave irradiation technique
IV	Drawing structures and reactions using chem draw®
V	Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)

Learning Resources

Recommended Books: (Latest Editions)

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

JSPM University Pune Third Year B. Pharmacy Semester- VI		
Course Type: NA	**Course Title: PHARMACOLOGY-III (THEORY)**	
Course Code: BP602T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and chrono pharmacology.		
Course Objectives: Upon completion of this course the student should be able to: 1. Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases 2. Comprehend the principles of toxicology and treatment of various poisonings and 3. Appreciate correlation of pharmacology with related medical sciences.		
Course Outcomes: On completion of the course, learner will be able to **CO1:** Explain the pharmacological actions, therapeutic uses, and adverse effects of drugs acting on the respiratory and gastrointestinal systems. **CO2:** Classify and compare various antimicrobial agents including antibiotics, antituberculars, and antifungals based on their mechanism of action and clinical application. **CO3:** Distinguish between different chemotherapeutic agents used in the treatment of viral, parasitic, and protozoal infections. **CO4:** Describe and evaluate the pharmacological basis of treatment of UTIs, STDs, malignancies, and immune-related conditions. **CO5:** Interpret the principles of toxicology and outline the treatment strategies for common poisonings including heavy metals and CNS depressants.		

CO6: Summarize the significance of biological rhythms and discuss the concept and applications of chrono pharmacology.

Course Contents

Unit I		**(10 Hours)**

1. Pharmacology of drugs acting on Respiratory system

a. Anti -asthmatic drugs

b. Drugs used in the management of COPD

c. Expectorants and antitussives

d. Nasal decongestants

e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

a. Antiulcer agents.

b. Drugs for constipation and diarrhoea.

c. Appetite stimulants and suppressants.

d. Digestants and carminatives.

e. Emetics and anti-emetics.

Unit II		**(10 Hours)**

3. Chemotherapy

a. General principles of chemotherapy.

b. Sulfonamides and cotrimoxazole.

c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

Unit III		**(10 Hours)**

3. Chemotherapy

a. Antitubercular agents

b. Antileprotic agents

c. Antifungal agents

d. Antiviral drugs

e.Anthelmintics

f. Antimalarial drugs

g. Antiamoebic agents

Unit IV		**(8 Hours)**

3. Chemotherapy

l. Urinary tract infections and sexually transmitted diseases.

m. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants

b. Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

Unit V		**(7 Hours)**

5. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.

b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

c. General principles of treatment of poisoning

d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

6. Chronopharmacology

a. Definition of rhythm and cycles.

b. Biological clock and their significance leading to chronotherapy.

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **PHARMACOLOGY-III (PRACTICAL)**	
Course Code: BP608P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**
Prerequisite Courses, if any: -		

Course Outcomes: On completion of the course, learner will be able to

CO1: Calculate dose and pharmacokinetic parameters using provided experimental data.

CO2: Demonstrate antiallergic and antiulcer activity using appropriate animal models.

CO3: Perform experiments to study drug effects on gastrointestinal motility and guinea pig ileum.

CO4: Apply biostatistical methods (t-test, ANOVA, chi-square, Wilcoxon test) to analyze pharmacological data.

CO5: Perform toxicity, irritation, and pyrogen testing using standard animal models and ethical practices.

CO6: Demonstrate ethical responsibility and sensitivity while handling laboratory animals and reporting observations.

List of Laboratory Experiments	
1.	Dose calculation in pharmacological experiments
2.	Antiallergic activity by mast cell stabilization assay
3.	Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4.	Study of effect of drugs on gastrointestinal motility
5.	Effect of agonist and antagonists on guinea pig ileum
6.	Estimation of serum biochemical parameters by using semi- autoanalyser
7.	Effect of saline purgative on frog intestine
8.	Insulin hypoglycemic effect in rabbit
9.	Test for pyrogens (rabbit method)
10.	Determination of acute oral toxicity (LD50) of a drug from a given data

11.	Determination of acute skin irritation / corrosion of a test substance
12.	Determination of acute eye irritation / corrosion of a test substance
13.	Calculation of pharmacokinetic parameters from a given data
14.	Biostatistics methods in experimental pharmacology(student's t test, ANOVA)
15.	Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)
	**Experiments are demonstrated by simulated experiments/videos*

Learning Resources

Recommended Books: (Latest Editions)

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

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

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams &Wilkins

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

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

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,

8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,

9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

JSPM University Pune

Third Year B. Pharmacy

Semester- VI

Course Type: NA	**Course Title:** **HERBAL DRUG TECHNOLOGY (THEORY)**	
Course Code: BP603T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

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

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

1. understand raw material as source of herbal drugs from cultivation to herbal drug product
2. know the WHO and ICH guidelines for evaluation of herbal drugs
3. know the herbal cosmetics, natural sweeteners, nutraceuticals
4. appreciate patenting of herbal drugs, GMP

Course Outcomes: On completion of the course, learner will be able to

CO1: Identify and classify herbal raw materials and cultivation practices.

CO2: Explain principles and preparation methods in Indian systems of medicine

CO3: Analyze nutraceuticals, their health benefits, and interaction

CO4: Identify herbal cosmetics and excipients; differentiate formulation types

CO5: Interpret guidelines for evaluation, stability, and patenting of herbal drugs

CO6: Summarize GMP norms and infrastructure for the herbal industry

Course Contents

Unit I		**(11 Hours)**

Herbs as raw materials

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material

Biodynamic Agriculture

Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

Indian Systems of Medicine

a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy

b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.

Unit II		**(7 Hours)**

Nutraceuticals

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

Unit III		**(10 Hours)**

Herbal Cosmetics

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Herbal excipients:

Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

Herbal formulations :

Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

Unit IV		**(10 Hours)**

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:

a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy

b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

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

Unit V		**(7 Hours)**

General Introduction to Herbal Industry

Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

Schedule T – Good Manufacturing Practice of Indian systems of medicine

Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

JSPM University Pune Third Year B. Pharmacy		
Course Type: NA	**Lab Course Title:** **HERBAL DRUG TECHNOLOGY (PRACTICAL)**	
Course Code: BP609P	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 2	**Lecture (L):** **Tutorial (T):** **Practical (P): 4** **Experiential Learning (EL):**	**Theory (TH):** **Practical (PR): 50 Marks** **Oral (OR):**

Prerequisite Courses, if any: -

Course Outcomes: On completion of the course, learner will be able to

CO1: Perform preliminary phytochemical screening of crude drugs

CO2: Evaluate pharmaceutical excipients of natural origin

CO3: Prepare and evaluate herbal formulations as per Pharmacopoeial standards

CO4: Analyze herbal drugs using monographs from official pharmacopoeias

CO5: Estimate alcohol, aldehyde, phenol, and total alkaloid content in herbal samples.

CO6: Formulate and assess herbal cosmetic products

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

Learning Resources

Recommended Books: (Latest Editions)

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

JSPM University Pune Third Year B. Pharmacy Semester- VI		
Course Type: NA	**Course Title: BIOPHARMACEUTICS AND PHARMACOKINETICS (THEORY)**	
Course Code: BP604T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		
Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.		
Course Objectives: Upon completion of the course student shall be able to: 1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance. 2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination. 3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance. 4. Understand various pharmacokinetic parameters, their significance & applications.		
Course Outcomes: On completion of the course, learner will be able to **CO1**: Understand drug absorption mechanisms and factors affecting drug absorption through GIT and other routes. **CO2:** Explain drug distribution, protein binding, and their clinical significance. **CO3:** Describe drug metabolism, renal and non-renal excretion, and factors influencing drug elimination. **CO4:** Understand bioavailability, bioequivalence, and methods to enhance drug dissolution and absorption.		

CO5: Apply pharmacokinetic models to calculate key parameters and understand drug behavior in the body.

CO6: Analyze multi-compartment and nonlinear pharmacokinetics, and calculate dosing regimens.

Course Contents

Unit I		**(10 Hours)**

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

Unit II		**(10 Hours)**

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo* correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

Unit III		**(10 Hours)**

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE, t1/2, Vd, AUC, Ka, Clt and CLR- definitions methods of eliminations, understanding of their significance and application

Unit IV		**(8 Hours)**

Multicompartment models: 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.

Unit V		**(7 Hours)**

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Learning Resources

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA
4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: ByMilo Glbaldi 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, Pennsylvnia

JSPM University Pune

Third Year B. Pharmacy

Semester- VI

Course Type: NA	**Course Title: PHARMACEUTICAL BIOTECHNOLOGY (THEORY)**	
Course Code: BP605T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**

Prerequisite Courses, if any:

Scope:

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

Course Objectives: Upon completion of the subject student shall be able to;

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

Course Outcomes: On completion of the course, learner will be able to

CO1: Explain the principles of biotechnology, enzyme technology, and genetic engineering used in pharmaceutical sciences.

CO2: Analyze applications of recombinant DNA technology in the production of hormones, vaccines, and therapeutic proteins

CO3: Evaluate methods of immunity development, vaccine production, and immune response mechanisms

CO4: Appreciate the role of microbial genetics and immune technology in healthcare and pharmaceutical industries

CO5: Demonstrate ethical responsibility in handling genetically modified organisms and biopharmaceutical products

CO6: Perform basic biotechnological techniques like ELISA, blotting, fermentation setup, and genetic manipulation using standard lab procedures.

Course Contents

Unit I		**(10 Hours)**

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.

Unit II		**(10 Hours)**

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

Unit III		**(10 Hours)**

Types of immunity- humoral immunity, cellular immunity

a) Structure of Immunoglobulins

b) Structure and Function of MHC

c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.

d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.

e) Storage conditions and stability of official vaccines

f) Hybridoma technology- Production, Purification and Applications

g) Blood products and Plasma Substituties.

Unit IV		**(8 Hours)**

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.

Unit V		**(7 Hours)**

a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.

b) Large scale production fermenter design and its various controls.

c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,

d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.

Learning Resources

Recommended Books: (Latest Editions)

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.

2. RA Goldshy et. al., : Kuby Immunology.

3. J.W. Goding: Monoclonal Antibodies.

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

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

6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.

7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

JSPM University Pune Third Year B. Pharmacy Semester- VI		
Course Type: NA	**Course Title: QUALITY ASSURANCE (THEORY)**	
Course Code: BP606T	**Teaching Scheme: 4 Hrs./Week**	**Examination Scheme:**
Credits: 4	**Lecture (L): 3** **Tutorial (T): 1** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 100 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

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

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

- understand the cGMP aspects in a pharmaceutical industry
- appreciate the importance of documentation
- understand the scope of quality certifications applicable to pharmaceutical industries
- understand the responsibilities of QA & QC departments

Course Outcomes: On completion of the course, learner will be able to

CO1: Explain the principles of quality assurance, GMP, TQM, ICH guidelines, and QbD in pharmaceutical manufacturing.

CO2: Analyze the organization of personnel, equipment, premises, and materials management as per GMP standards.

CO3: Evaluate the importance of calibration, validation, and documentation in maintaining pharmaceutical quality systems.

CO4: Demonstrate a professional attitude towards quality systems and compliance with regulatory practices.

CO5: Value the ethical responsibilities involved in complaint handling, recalls, and maintaining accurate records.

CO6: Perform calibration of instruments and prepare standard quality documents following good documentation practices.

Course Contents

Unit I		(10 Hours)
Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP **Total Quality Management (TQM):** Definition, elements, philosophies **ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines **Quality by design (QbD)**: Definition, overview, elements of QbD program, tools **ISO 9000 & ISO14000**: Overview, Benefits, Elements, steps for registration **NABL accreditation** : Principles and procedures		
Unit II		**(10 Hours)**
Organization and personnel: Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.		
Unit III		**(10 Hours)**
Quality Control: Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities		
Unit IV		**(8 Hours)**
Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.		
Unit V		**(7 Hours)**
Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management		

Learning Resources

Recommended Books: (Latest Editions)

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

JSPM University Pune Third Year B. Pharmacy Semester- VI		
Course Type: MLC#	**Course Title: BASICS OF DISASTER MANAGEMENT**	
Course Code: BP610T	**Teaching Scheme: 1 Hrs./Week**	**Examination Scheme:**
Credits: 1	**Lecture (L): 1** **Tutorial (T):** **Practical (P):** **Experiential Learning (EL):**	**Theory (TH): 50 Marks** **Practical (PR):** **Oral (OR):**
Prerequisite Courses, if any:		

Scope: The audit course "Basics of Disaster Management" provides students with foundational knowledge and practical awareness of various types of disasters, their causes, and the strategies for preparedness, mitigation, response, and recovery. The course aims to build a sense of responsibility, resilience, and readiness among students to manage and respond effectively during natural or man-made disasters.

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

1. To familiarize students with disaster management principles within healthcare systems.
2. To understand the roles of healthcare professionals, especially pharmacists, during emergencies.
3. To train students in handling pharmaceutical logistics and public health responsibilities during disasters.
4. To integrate theoretical knowledge with practical approaches in healthcare disaster response.

Course Outcomes: On completion of the course, learner will be able to

CO1: Understand types, phases, and the disaster management cycle, including roles of national and international bodies.

CO2: Explain the structure of healthcare systems and assess their preparedness during disasters.

CO3: Describe the pharmacist's role in emergency medication management and chronic disease care during disasters.

CO4: Understand public health challenges during disasters, including outbreak control, WASH, and mental health support.

CO5: Recognize the importance of community engagement and the role of pharmacists in disaster risk reduction.

CO6: Analyze real-life disaster case studies and develop practical pharmacy disaster response plans.

Course Contents

Unit I	**Fundamentals of Disaster Management**	**(3 Hours)**

- Types of disasters (natural, biological, chemical, man-made)
- Phases: Prevention, Preparedness, Response, Recovery (PPRR)
- Disaster management cycle
- National and international disaster management bodies (NDMA, WHO, UNDRR)

Unit II	**Healthcare System and Disaster Preparedness**	**(3 Hours)**

- Structure of healthcare systems and their vulnerability
- Emergency medical services (EMS)
- Role of hospitals and community health centers
- Hospital disaster preparedness and triage protocols

Unit III	**Pharmacist's Role in Disaster Management**	**(2 Hours)**

- Emergency medication management
- Ensuring access to essential drugs
- Managing chronic diseases during disasters (e.g., diabetes, hypertension)
- Communication with patients and healthcare teams

Unit IV	**Public Health in Disasters**	**(3 Hours)**

- Outbreak control and vaccination during disasters
- Water, sanitation, and hygiene (WASH)
- Mental health and psychological first aid
- Emergency preparedness in epidemics and pandemics

Unit V	**Disaster Risk Reduction and Community Engagement**	**(2 Hours)**

- Community-based disaster risk reduction (CBDRR)
- Public awareness and education
- Role of NGOs and local health authorities
- Pharmacists as community educators and first responders

UNIT VI	Case Studies, Projects, and Evaluation	(2 Hours)

- Case studies: COVID-19, Bhopal Gas Tragedy, Kerala Floods, etc.
- Disaster simulation exercises
- Group project: Design a pharmacy disaster response plan
- Presentation and feedback

Learning Resources

Recommended Books: (Latest Editions)

1. Harsh K. Gupta Textbooks of Disaster Management" Universities Press Covers fundamental disaster types, management cycles, and national/international frameworks.
2. Dr. Satish Modh Textbook of Disaster Management Macmillan Publishers Focuses on disaster preparedness, response strategies, and community engagement with case studies.
3. Damon P. Coppola "Introduction to International Disaster Management" Butterworth-Heinemann (Elsevier) 3rd Edition Global perspective on disaster risk management, preparedness, and public health responses.
4. Lauren S. Schlesselman "Pharmacy Emergency Preparedness and Response" American Pharmacists Association (APhA) Specific to the pharmacist's role in disaster scenarios including medication management and triage.
5. AFMC Pune, WHO Collaboration "Textbook of Public Health and Community Medicine" CBS Publishers Relevant for healthcare structure, WASH, epidemic control, and emergency public health.
6. Linda Young Landesman "Public Health Management of Disasters: The Practice Guide" American Public Health Association (APHA) includes mental health, emergency services, and public health systems during disasters.
7. **NDMA (India):** https://ndma.gov.in
8. **WHO Health Emergency Preparedness:** https://www.who.int
9. **UNDRR Resources:** https://www.undrr.org