Preamble:

The undergraduate programmes at the Institute of Chemical Technology are reputed worldwide. Alumni from these programmes have found a place of pride in the Indian pharmaceutical and chemical industry including some top names and many as entrepreneurs, in Universities/ Institutes and Research Organisations throughout India and the world. The B.Pharm. programmes in the then Department of Chemical Technology, University of Mumbai started in 1959, keeping national, societal needs in focus, post-independence. In compliance with PCI regulations, the current syllabus follows the syllabus mandated by PCI.

All the courses are credit based and the evaluation are grade based. The credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits is based on student workload, learning outcomes and contact hours. This system is described in detail in Regulation No.9 of the Institute. Each theory course consists of Lectures and tutorials. During tutorial session, it is expected that the problem solving / case studies / relevant real life applications / student presentations / home assignments/individual or group projects are discussed in the presence of the teacher. Teacher can have the freedom to interchange lectures / tutorials depending upon the topic. Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation.

B. Pharm

PROGRAMME EDUCATIONAL OBJECTIVES for B. Pharm

PEO-1: To generate excellent trained undergraduates with state of art knowledge in pharmacy and allied subjects in an ambience of motivation that could stimulate growth and excellence

PEO-2: To create undergraduates who are trained in sync with national healthcare programmes

PEO-3: To create professionals of standing who would spread across the country and the globe in various areas including education, research, industry and government.

PEO-4: To mold students to emerge as future leaders of the pharmacy profession

PEO-5: To sensitize students to local and global needs of environment protection and sustainability

Programme Outcomes (POs) for B. Pharm

PO1	Have knowledge of Pharmacy related subjects, allied subjects including biomedical, and administrative pharmacy related aspects.
PO2	Have Ability in planning and time management, implementation, organization, delegation and resource management.
PO3	Have analytical, logical and scientific ability to evaluate problems and arrive at effective decisions.
PO4	Be adept in the use of modern methods and appropriate tools and resources related to pharmacy with a good understanding of the same.
PO5	Have leadership skills, understanding human behaviour, enable team building and provide motivation as important facets of development. Such development to be directed for the health and welfare of society through participation as responsible citizens.
PO6	Be pharmaceutical professionals who understand their role as educators and professionals for the promotion of healthcare in society
PO7	Be ethical professionals of the pharmacy profession who respect and honour personal values and follow ethical principles in professional and social life and assume responsibility for their actions.
PO8	Have effective communication skills both spoken and written. This would ensure appropriate communication with society at large, and the ability to present and write effective reports.
PO9	Be stake holders in contributing to national healthcare, imbibe sufficient knowledge to assess societal, health, safety and legal issues and the consequent responsibilities.
PO10	Appreciate the need and importance of environment protection and sustainable development and promote the same in the context of the pharmacy profession
PO11	Have the passion for lifelong learning and the ability to engage in the same independently and hence adapt readily to technological changes. Identify learning needs as a practice and work on them regularly through upgradation

Semester I									
Course Code	**Subjects**	**Credits**	**Hrs/Week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
PHT1122	Human Anatomy and Physiology I–Theory	4	3	1	-	20	30	50	100
PHT1123	Pharmaceutical Analysis I – Theory	4	3	1	-	20	30	50	100
PHT1124	Pharmaceutics I – Theory	4	3	1	-	20	30	50	100
PHT1125	Pharmaceutical Inorganic Chemistry –Theory	4	3	1	-	20	30	50	100
HUT1113	Communication skills – Theory *	2	2	-	-	10	15	25	50
PHT1126 PHT1127	Remedial Biology/ Remedial Mathematics – Theory*	2	2	-	-	10	15	25	50
PHP1128	Human Anatomy and Physiology –Practical	2	-	-	4	25	-	25	50
PHP1129	Pharmaceutical Analysis I – Practical	2	-	-	4	25	-	25	50
PHP1130	Pharmaceutics I – Practical	2	-	-	4	25	-	25	50
PHP1131	Pharmaceutical Inorganic Chemistry – Practical	2	-	-	4	25	-	25	50
HUP1114	Communication skills – Practical*	1	-	-	2	10	-	15	25
PHP1132	Remedial Biology – Practical*	1	-	-	2	10	-	15	25
	TOTAL:	**27/29$/30#**	**14/16$#**		**18/20#**				**675/725$/750#**

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

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

Semester II

Subject Code	Subjects	Credits	Hrs/week			Marks for various Exams			
			L	T	P	C.A.	M.S.	E.S.	Total
PHT1128	Human Anatomy and Physiology II – Theory	4	3	1	-	20	30	50	100
PHT1129	Pharmaceutical Organic Chemistry I – Theory	4	3	1	-	20	30	50	100
PHT1130	Biochemistry – Theory	4	3	1	-	20	30	50	100
PHT1131	Pathophysiology – Theory	4	3	1	-	20	30	50	100
PHT1132	Computer Applications in Pharmacy – Theory *	2	3	-	-	15	20	40	75
HUT1114	Environmental sciences – Theory *	3	3	-	-	15	20	40	75
PHP1133	Human Anatomy and Physiology II –Practical	2	-	-	4	25	-	25	50
PHP1134	Pharmaceutical Organic Chemistry I– Practical	2	-	-	4	25	-	25	50
PHP1135	Biochemistry – Practical	2	-	-	4	25	-	25	50
PHP1136	Computer Applications in Pharmacy – Practical*	1	-	-	2	10	-	15	25
	TOTAL:	**28**	**18**	**4**	**14**				**725**

Syllabus Structure B. Pharm Second Year									
Semester III									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E.S.**	**Total**
PHT1133	Pharmaceutical Organic Chemistry II – Theory	4	3	1	-	20	30	50	100
PHT1134	Physical Pharmaceutics I – Theory	4	3	1	-	20	30	50	100
PHT1135	Pharmaceutical Microbiology – Theory	4	3	1	-	20	30	50	100
PHT1136	Pharmaceutical Engineering – Theory	4	3	1	-	20	30	50	100
PHP1137	Pharmaceutical Organic Chemistry II – Practical	2	3	-	4	25	-	25	50
PHP1138	Physical Pharmaceutics I – Practical	2	3	-	4	25	-	25	50
PHP1139	Pharmaceutical Microbiology – Practical	2	-	-	4	25	-	25	50
PHP1140	Pharmaceutical Engineering –Practical	2	-	-	2	25	-	25	50
	TOTAL:	**24**	**18**	**4**	**14**				**600**
Semester IV									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C. A.**	**M.S.**	**E. S.**	**Total**
PHT1137	Pharmaceutical Organic Chemistry III– Theory	4	3	1	-	20	30	50	100
PHT1138	Medicinal Chemistry I – Theory	4	3	1	-	20	30	50	100
PHT1139	Physical Pharmaceutics II – Theory	4	3	1	-	20	30	50	100
PHT1140	Pharmacology I – Theory	4	3	1	-	20	30	50	100
PHT1141	Pharmacognosy I – Theory	4	3	1	-	20	30	50	100
PHP1141	Medicinal Chemistry I – Practical	2	-	-	4	25	-	25	50
PHP1142	Physical Pharmaceutics II – Practical	2	-	-	4	25	-	25	50
PHP1143	Pharmacology I – Practical	2	-	-	4	25	-	25	50
PHP1144	Pharmacognosy I – Practical	2	-	-	4	25	-	25	50
	TOTAL	28	15	5	12				700
Syllabus Structure B. Pharm Third Year									
Semester V									

Subject Code	Subjects	Credits	Hrs /week			Marks for various Exams			
			L	T	P	C. A.	M.S.	E. S.	Total
PHT1142	Medicinal Chemistry II – Theory	4	3	1	-	20	30	50	100
PHT1143	Industrial PharmacyI– Theory	4	3	1	-	20	30	50	100
PHT1144	Pharmacology II – Theory	4	3	1	-	20	30	50	100
PHT1145	Pharmacognosy and Phytochemistry II– Theory	4	3	1	-	20	30	50	100
PHT1146	Pharmaceutical Jurisprudence – Theory	4	3	1	-	20	30	50	100
PHP1145	Industrial PharmacyI – Practical	2	-	-	4	25	-	25	50
PHP1146	Pharmacology II – Practical	2	-	-	4	25	-	25	50
PHP1147	Pharmacognosy and Phytochemistry II – Practical	2	-	-	4	25	-	25	50
	TOTAL	**26**	**15**	**5**	**12**				**650**
Semester VI									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E. S.**	**Total**
PHT1147	Medicinal Chemistry III – Theory	4	3	1	-	20	30	50	100
PHT1148	Pharmacology III – Theory	4	3	1	-	20	30	50	100
PHT1149	Herbal Drug Technology – Theory	4	3	1	-	20	30	50	100
PHT1150	Biopharmaceutics and Pharmacokinetics – Theory	4	3	1	-	20	30	50	100
PHT1151	Pharmaceutical Biotechnology – Theory	4	3	1	-	20	30	50	100
PHT1152	Quality Assurance –Theory	4	3	1	-	20	30	50	100
PHP1148	Medicinal chemistry III – Practical	2	-	-	4	25	-	25	50
PHP1149	Pharmacology III – Practical	2	-	-	4	25	-	25	50
PHP1150	Herbal Drug Technology – Practical	2	-	-	4	25	-	25	50
	TOTAL:	**30**	**18**	**6**	**12**				**750**

Syllabus Structure B. Pharm Final Year									
Semester VII									
Subject Code	**Subjects**	**Credits**	**Hrs/week**			**Marks for various Exams**			
			L	**T**	**P**	**C. A.**	**M.S.**	**E.S.**	**Total**
PHT1153	Instrumental Methods of Analysis – Theory	4	3	1	-	20	30	50	100
PHT1154	Industrial PharmacyII – Theory	4	3	1	-	20	30	50	100
PHT1155	Pharmacy Practice – Theory	4	3	1	-	20	30	50	100
PHT1156	Novel Drug Delivery System – Theory	4	3	1	-	20	30	50	100
PHP1151	Instrumental Methods of Analysis – Practical	2	-	-	4	25	-	25	50
PHP1152	Practice School*	6	-	-	12	50	-	100	150
	TOTAL:	24	12	4	16				600
Semester VIII									
Subject Code	**Subjects**	**Credits**	**Hrs /week**			**Marks for various Exams**			
			L	**T**	**P**	**C.A.**	**M.S.**	**E. S.**	**Total**
PHT1157	Biostatistics and Research Methodology	4	3	1		20	30	50	100
PHT1158	Social and Preventive Pharmacy	4	3	1		20	30	50	100
*PHT1159	Pharma Marketing Management	4	3	1		20	30	50	100
*PHT1160	Pharmaceutical Regulatory Science	4	3	1		20	30	50	100
*PHT1161	Pharmacovigilance	4	3	1		20	30	50	100
*PHT1162	Quality Control and Standardization of Herbals	4	3	1		20	30	50	100
*PHT1163	Computer Aided Drug Design	4	3	1		20	30	50	100
*PHT1164	Cell and Molecular Biology	4	3	1		20	30	50	100
*PHT1165	Cosmetic Science	4	3	1		20	30	50	100
*PHT1166	Experimental Pharmacology	4	3	1		20	30	50	100
*PHT1167	Advanced Instrumentation Techniques	4	3	1		20	30	50	100
*PHT1168	Dietary Supplements and	4	3	1		20	30	50	100

	Nutraceuticals								
PHP1153	Project Work	6	-	-		50	-	100	150
	TOTAL	**22**							**550**
*Any two courses from **PHT1159** to **PHT1168** to be taken as electives									

Semester I

	Course Code: PHT1122	Course Title: HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)	Credits = 4		
			L	T	P
	Semester: I	Total contact hours: 60 hours	3	1	0

List of Prerequisite Courses

HSC(Biology)

List of Courses where this course will be prerequisite

Human anatomy and physiology-II, Pharmacology, Medicinal chemistry,Clinical Pharmacy

Description of relevance of this course in the B. Pharm programme

This will enable students to understand the basic structure, function and location of organs of human body and apply it to understand the pharmacology, clinical pharmacy, health awareness and family planning

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.

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.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**Unit I:** • **Introduction to human body** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. • **Cellular level of organization** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine • **Tissue level of organization** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	**10**

2	**Unit II** • **Integumentary system** Structure and functions of skin • **Skeletal system** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction • **Joints** Structural and functional classification, types of joints movements and its articulation.	**10**
3	**Unit III** • **Body fluids and blood** • Body fluids, composition, and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. • **Lymphatic system** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system	**10**
4	**Unit IV** • **Peripheral nervous system**: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. • **Special senses** Structure and functions of eye, ear, nose, and tongue and their disorders.	**06**
5	**Unit V** • **Cardiovascular system** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein, and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram, and disorders of heart.	**07**

Course Outcomes (Students will be able to…..)	
CO1	Understand the gross morphology, structure and functions of various organs of the human body.
CO2	Understand various homeostatic mechanisms and their imbalances.
CO3	Identify the various tissues and organs of different systems of human body.
CO4	Appreciate coordinated working pattern of different organs of each system.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K2	3	2	3	3	2	3	2	2	2	2	2
CO2	K2	3	2	3	1	2	2	2	2	2	2	2
CO3	K2	3	2	3	3	2	2	2	2	2	2	2
CO4	K2	3	2	3	1	2	2	2	2	2	2	2
Course	K2	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1123	Course Title: PHARMACEUTICAL ANALYSIS (Theory)	Credits =4		
			L	T	P
	Semester: I	Total contact hours: 60 hours	3	1	-

List of Prerequisite Courses	
	HSC(Chemistry)

List of Courses where this course will be prerequisite	
	Pharmaceutical Analysis II and III, Organic Chemistry I and II

Description of relevance of this course in the B. Pharm programme

To train the students with respect to basics of titrations and electroanalytical chemistry.

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

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

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**UNIT-I** **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 **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures Pharmacopoeia, Sources of impurities in medicinal agents,limit tests.	**10 Hours**
2	**UNIT-II** **Acid base titration**: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, andvery weak acids and bases, neutralization curves **Non aqueous titration**: Solvents, acidimetry and alkalimetry titration andestimation of Sodium benzoate and Ephedrine HCl	**10 Hours**

3	**UNIT-III** **Precipitation titrations**: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration**: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. **Gravimetry**: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.	**10 Hours**
4	**UNIT-IV** **Redox titrations** (a) Concepts of oxidation and reduction (b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration withpotassium iodate	**08 Hours**
5	**UNIT-V** **Electrochemical methods of analysis** **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications. **Potentiometry -** Electrochemical cell, construction and workingof 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	**07 Hours**
Course Outcomes (students will be able to….)		
1	Understand the principles of volumetric and electro-chemical analysis	
2	Carry out various volumetric and electro-chemical titrations	
3	Develop analytical skills	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**P10**	**P11**
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K3	3	3	3	1	2	2	2	2	2	3	2
CO2	K3	3	3	3	1	2	2	2	2	2	3	2
CO3	K3	3	3	3	1	2	2	2	2	2	3	3
Course	K3	3	3	3	3	3	3	3	3	3	3	3

	Course Code: PHT1124	Course Title: PHARMACEUTICS- I (Theory)	Credits = 4		
			L	T	P
	Semester: I	Total contact hours: 60 hours	3	1	-

List of Prerequisite Courses	
	HSC(Science)

List of Courses where this course will be prerequisite	
	Pharmaceutics II

Description of relevance of this course in the B. Pharm programme

To train the students with respect to basics of pharmaceutics and in-depth knowledge of monophasic and biphasic pharmaceutical products.

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.

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 andpharmaceutical calculations

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**UNIT-I** **Historical background and development of profession of pharmacy**: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription andErrors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculationsbased on age, body weight and body surface area.	**10 Hours**
2	**UNIT-II** **Pharmaceutical calculations**: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Powders:** Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and	**10 Hours**

3	**UNIT-III** **Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **Biphasic liquids:** **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. **Emulsions:** Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.	**08 Hours**
4	**UNIT-IV** **Suppositories**: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities**: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	**08 Hours**
5	**UNIT-V** Semisolid dosage forms: Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	**07 Hours**

Course Outcomes (students will be able to….)		
1	Understand the history of profession of pharmacy.	
2	Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations	
3	Understand and use pharmacopoeia	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K1	2	2	2	1	2	2	2	3	2	2	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	K2	3	2	2	1	3	2	3	3	3	3	3

	Course Code: PHT1125	Course Title: PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)	Credits =4		
			L	T	P
	Semester: I	Total contact hours: 60 hours	3	1	-
List of Prerequisite Courses					
	HSC(Chemistry)				
List of Courses where this course will be prerequisite					
	All pharmaceutical and medicinal chemistry courses				
Description of relevance of this course in the B. Pharm programme					
To train the students with respect to basics of inorganic chemistry and coordination chemistry					

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

Objectives: Upon completion of course, student shall be able to

a. know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
b. understand the medicinal and pharmaceutical importance of inorganic compounds

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**UNIT-I** **Impurities in pharmaceutical substances:** History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate **General methods of preparation**, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes	**10 Hours**
2	**UNIT-II** **Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes**: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*,	**10 Hours**

3	**UNIT-III** **Gastrointestinal agents** **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture **Cathartics:** Magnesium sulphate, Sodium rthophosphate, Kaolin andBentonite **Antimicrobials**: Mechanism, classification, Potassium ermanganate, Boricacid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its	**10 Hours**
4	**UNIT-IV** **Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. **Emetics**: Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodiumnitrite333 **Astringents**: Zinc Sulphate, Potash Alum	**08 Hours**
5	**UNIT-V** **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.	**07 Hours**

	Course Outcomes (students will be able to….)	
1	Identify the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals.	
2	Understand the medicinal and pharmaceutical importance of inorganic compounds	
3	Understand the chemistry of acids, bases and buffers.	

4	Understand the composition and functions of main electrolytes in the body.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K3	3	2	2	1	3	2	3	3	3	3	3
CO3	K3	3	3	3	2	3	3	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	K3	3	3	3	2	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: HUT1113	Course Title: COMMUNICATION SKILLS (Theory)	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 30 hours	2	-	-
List of Prerequisite Courses					
	Not Applicable				
List of Courses where this course will be prerequisite					
	All courses				
Description of relevance of this course in the B. Pharm programme					
Enable students to communicate more effectively in written and spoken English.					

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.

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

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**UNIT-I** **Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment	**07 Hours**

2	**UNIT-II** **Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	**07 Hours**
3	**UNIT-III** **Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming anActive 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	**07 Hours**
4	**UNIT-IV** **Interview Skills:** Purpose of an interview, Do's and Dont's of an interview **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring YourPresentation, Delivering Your Presentation, Techniques of Delivery	**05 Hours**
5	**UNIT-V** **Group Discussion:** Introduction, Communication skills in group discussion, Do's andDont's of group discussion	**04 Hours**

Course Outcomes (students will be able to….)		
CO1	Understand basics of communication and build a self image	
CO2	Understand and implement techniques of oral and written communication and group discussion	
CO3	Face interviews effectively	

CO4	Express themselves assertively and clearly	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K2,A	1	2	1	1	3	2	2	3	2	1	1
CO2	K2,A	1	2	1	1	3	2	2	3	2	1	1
CO3	K2,A	1	2	1	1	3	2	2	3	2	1	1
CO4	K2,A	1	2	1	1	3	2	2	3	2	1	1
CO5	K2,A	1	2	1	1	3	2	2	3	2	1	1
Course	K2,A	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1126	Course Title: REMEDIAL BIOLOGY (Theory)	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 30 hours	2	-	-
List of Prerequisite Courses					
	Not applicable				
List of Courses where this course will be prerequisite					
	Human anatomy and physiology I and II, Pharmacognosy I				
Description of relevance of this course in the B. Pharm programme					
To train students to understand the basics of plant and human biology					

Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

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

1. know the classification and salient features of five kingdoms of life
2. understand the basic components of anatomy & physiology of plant
3. understand the basic components of anatomy & physiology animal withspecial reference to human

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	**UNIT-I** **Living world:** Definition and characters of living organisms Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera,Potista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** Morphology of different parts of flowering plants – Root, stem, inflorescence,flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones	**07 Hours**

2	**UNIT-II** **Body fluids and circulation** Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system Structure of human heart and blood vessels Cardiac cycle, cardiac output and ECG **Digestion and Absorption** Human alimentary canal and digestive glands Role of digestive enzymes Digestion, absorption and assimilation of digested food **Breathing and respiration** Human respiratory system Mechanism of breathing and its regulation Exchange of gases, transport of gases and regulation of respiration Respiratory volumes	**7 Hours**

3	**UNIT-III** **Excretory products and their elimination** Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotensin system **Neural control and coordination** Definition and classification of nervous system Structure of a neuron Generation and conduction of nerve impulse Structure of brain and spinal cord Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata **Chemical coordination and regulation** Endocrine glands and their secretions Functions of hormones secreted by endocrine glands **Human reproduction** Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle	**07 Hours**
4	**UNIT-IV** **Plants and mineral nutrition:** Essential mineral, macro and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affectingphotosynthesis.	**05 Hours**
5	**UNIT-V** **Plant respiration:**Respiration, glycolysis, fermentation (anaerobic). Cell - The unit of life Structure and functions of cell and cell organelles.Cell division **Tissues** Definition, types of tissues, location and functions.	**04 Hours**
List of Text Books/Reference Books		

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

Course Outcomes (Students will be able to…..)	
CO1	Understand the classification and salient features of five kingdoms of life
CO2	Understand the basic components of anatomy & physiology of plant
CO3	Understand the basic components of anatomy & physiology animal withspecial reference to human

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K2	3	2	3	3	2	3	2	2	2	2	2
CO2	K2	3	2	3	1	2	2	2	2	2	2	2
CO3	K2	3	2	3	3	2	2	2	2	2	2	2
Course	K2	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1127	Course Title: REMEDIAL MATHEMATICS (Theory)	Credits= 2		
	Semester : I	Total Contact Hours: 30	L	T	P
			2	-	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All Subjects

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT – I** **Partial fraction** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction , Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function*:*** Real Valued function, Classification of real valued functions, **Limits and continuity :** Introduction , Limit of a function, Definition of limit of a function	06 Hours

2	**UNIT –II** **Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem,Applicationof Matrices in solving Pharmacokinetic equations	06 Hours
3	**UNIT – III** **Calculus** **Differentiation** : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of x^n *w.r.t*x,where *n* is any rational number, Derivative of e^x,, Derivative of $\log_e x$, Derivative of a^x,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application	06 Hours
4	**UNIT – IV** **Analytical Geometry** **Introduction:** Signs of the Coordinates, Distance formula, **Straight Line** : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line **Integration:** Introduction, Definition, Standard formulae, Rules of integration , Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application	06 Hours
5	**UNIT-V** **Differential Equations** : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**	06 Hours

	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**	
	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students 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	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	2	2	2	3	2	2	2	2	2	2	2
CO2	K2	2	2	2	3	2	2	2	2	2	2	2
CO3	K2	2	2	2	3	2	2	2	2	2	2	2
Course	**K2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1128	Course Title:. HUMAN ANATOMY AND PHYSIOLOGY (Practical)	Credits = 2		
			L	T	P
	Semester: I	Total contact hours: 60 hours	-	-	4

	List of Prerequisite Courses	
	HSC(Biology)	

	List of Courses where this course will be prerequisite	
	Human anatomy and physiology-II, Pharmacology laboratory	

Description of relevance of this course in the B. Pharm programme

To train students with respect to microscopic techniques, handling and analysing biologic samples for different parameters. It will help a student to read and understand the blood reports as well.

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.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	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	**07 Hours**

List of Text Books/Reference Books

1	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
	Physiological basis of Medical Practice-Best and Tailor. Williams & WilkinsCo.Riverview.MI.USA
	Text book of Medical Physiology- Arthur C.Guyton andJohn.E. Hall.

	Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.	
	Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers,New Delhi.	
	` Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma,Jaypee brother's medical publishers, New Delhi.	
	Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview, MI USA	
	Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH,U.S.A.	
	Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH,U.S.A.	

Course Outcomes (Students will be able to…..)	
CO1	Evaluate and measure his/her own blood parameters(Hb/RBC/WBC/Clotting time/Blood group/bleeding time.
CO2	Identify the organs of the skeletal system
CO3	Use compound microscope
CO4	Identify the cellular structures of the internal organs on the basis of histology

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
		K3	K4	K4	K6	K3,P	K4	K3,A	K2,A	K3,A	K3,P	K2,A+P
CO1	K5	2	3	3	3	2	3	2	2	2	2	2
CO2	K3	3	3	3	2	3	3	3	3	3	3	3
CO3	K3	3	3	3	2	3	3	3	3	3	3	3
CO4	K3	3	3	3	3	2	3	3	3	3	3	3
Course	K5	3	3	3	3	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1129	Course Title: Pharmaceutical Analysis (Practical)	Credits= 2		
	Semester : I	Total Contact Hours: 60 hrs.	L	T	P
			-	-	4

List of Prerequisite Courses

HSC(Chemistry)

List of Courses where this course will be Prerequisite

Pharmaceutical analysis laboratory II

Description of relevance of this course in the B. Pharm Programme

To train students with respect to titrimetric and electro-analytical methods of analysis and make them aware of good laboratory practices and apparatus handling.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Limit Test of the following** (1) Chloride (2) Sulphate (3) Iron (4) Arsenic	
2	**Preparation and standardization of** (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate	
3	**Assay of the following compounds along with Standardization of Titrant** (1) Ammonium chloride by acid base titration (2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration	
4	**Determination of Normality by electro-analytical methods** (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base	
	List of Text Book/ Reference Books	
	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.	

Course Outcomes (Students will be able to…..)		
CO1	Perform analysis using titrimetry and electroanalytical methods.	
CO2	Understanding importance of analytical accuracy.	
CO3	Appreciate basic laboratory analytical techniques.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	1	2	2	1	2	2	2
CO2	K2	3	1	3	3	1	2	2	1	2	2	2
CO3	K2	3	1	3	3	1	2	2	1	2	2	2
Course	**K2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1130	Course Title: PHARMACEUTICS-I (Practical)	Credits= 2		
	Semester : I	Total Contact Hours: 60 hrs.	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmaceutics-I

List of Courses where this course will be Prerequisite

Pharmaceutics Laboratory II, Dispensing pharmacy laboratory, Cosmeticology laboratory

Description of relevance of this course in the B. Pharm Programme

To train the students with respect to practical aspects of monophasic and biphasic pharmaceutical formulation development and their quality control

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Syrups** a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BP'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) Carbopal gel	
10	**Gargles and Mouthwashes** a) Iodine gargle b) Chlorhexidine mouthwash	

	List of Text Book/ Reference Books	
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's 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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand basic calculations for formulations, concepts of dilutions.	
CO2	Prepare, evaluate and label pharmacopoeial and non-pharmacopoeial monophasic liquid oral formulation	
CO3	Prepare, evaluate and label pharmacopoeial and non-pharmacopoeial biphasic and semisolid formulations	
C04	Proposed type of containers specific to product application.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K5	2	3	3	3	2	3	2	2	2	2	2
CO3	K5	2	3	3	3	2	3	2	2	2	2	2
CO4	K3	3	3	3	2	3	3	3	3	3	3	3
Course	**K5**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1131	Course Title: PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)	Credits= 2		
	Semester : I	Total Contact Hours: 60 Hr	L	T	P
			-	-	4

List of Prerequisite Courses

HSC(Chemistry)

List of Courses where this course will be Prerequisite

Organic Chemistry, Medicinal Chemistry Laboratory

Description of relevance of this course in the B. Pharm Programme

To train students with respect to testing and identification of inorganic impurities in pharmaceuticals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Limit tests for following ions** Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates Limit test for Iron Limit test for Heavy metals Limit test for Lead Limit test for Arsenic	
2	**Identification test** Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate	
3	**Test for purity** Swelling power of Bentonite Neutralizing capacity of aluminum hydroxide gel Determination of potassium iodate and iodine in potassium Iodide	
4	**Preparation of inorganic pharmaceuticals** Boric acid Potash alum Ferrous sulphate	
	List of Text Book/ Reference Books	
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	
	Course Outcomes (Students will be able to…..)	
CO1	Perform limit tests to identify inorganic impurities in pharmaceutical preparations.	
CO2	Prepare various inorganic pharmaceuticals.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K5	2	3	3	3	2	3	2	2	2	2	2
CO2	K5	2	3	3	3	2	3	2	2	2	2	2
Course	**K5**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: HUP1114	Course Title: COMMUNICATION SKILLS (Practical)	Credits= 1		
	Semester : I	Total Contact Hours: 30 hrs.	L	T	P
			0	0	2

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All courses

Description of relevance of this course in the B. Pharm Programme

To train the students to build their communication skills (oral and written), self image and train them to face interviews more effectively.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Basic communication covering the following topics** Meeting People Asking Questions Making Friends What did you do? Do's and Don't's	
2	**Pronunciations covering the following topics** Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds)	
3	**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	
	List of Text Book/ Reference Books	
	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, 5th Edition, Pearson, 2013	
6	Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010	
7	Communication skills for professionals, Konarnira, 2nd Edition, New arrivals –PHI, 2011	
8	Personality development and soft skills, Barun K Mitra, 1st Edition, Oxford Press, 2011	
9	Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India Pvt. Ltd, 2011	
10	Soft skills and professional communication, Francis Peters SJ, 1st Edition, Mc Graw Hill Education, 2011	
11	Effective communication, John Adair, 4th Edition, Pan Mac Millan,2009	
12	Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 1999	
	Course Outcomes (Students will be able to…..)	
CO1	Communicate better and follow the etiquettes of communication.	
CO2	Write effective emails and make good presentations	
CO3	Face interviews confidently	
C04	Improve themselves in terms of public speaking and overall communication.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K3	1	2	2	1	3	2	2	3	2	2	3
CO2	K3	1	2	2	1	3	2	2	3	2	2	3
CO3	K3	1	2	2	1	3	2	2	3	2	2	3
CO4	K3	1	2	2	1	3	2	2	3	2	2	3
Course	**K3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1132	Course Title: REMEDIAL BIOLOGY (Practical)	Credits= 2		
	Semester : I	Total Contact Hours: 30 hours	L	T	P
			-	-	2

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

Human anatomy and physiology laboratory

Description of relevance of this course in the B. Pharm Programme

To train students with respect to practical aspects of biology like microscope handling, section cutting techniques, staining and identification of various tissues.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
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 cells and their inclusions	
3	Study of Stem, Root, Leaf, seed, fruit, flower and their modifications	
4	Detailed study of a 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	
	List of Text Book/ 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	

	Course Outcomes (Students will be able to…..)	
CO1	Identify the cellular structure of plant tissues and human internal organs using microscope	
CO2	Measure blood pressure, heart rate, pulse rate and tidal volume	
CO3	Identify the organs of the skeletal system	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	3	3	3	3	3	3	3	2	2	2
CO2	K4	3	3	3	3	3	3	2	3	2	2	2
CO3	K3	3	3	3	3	3	3	2	3	2	2	2
Course	**K5**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester II

	Course Code: PHT1128	Course Title: HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)	Credits= 4		
	Semester: II	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Human anatomy and physiology-I (theory)

List of Courses where this course will be Prerequisite

Pathophysiology, pharmacology, clinical and hospital pharmacy, pharmaceutical technology

Description of relevance of this course in the B. Pharm Programme

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.

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. Appreciate coordinated working pattern of different organs of each system
5. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity)	10 hours
2	**Unit II** **Digestive system**	06 hours

	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.	
3	**Unit III** **Respiratory system** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.	10 hours
4	**Unit IV** **Endocrine system** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.	10 hours
5	**Unit V** **Reproductive system** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	09 hours
	List of Text Book/ Reference Books	

	1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi. 2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York 3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA 4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A. 5. Principles of Anatomy and Physiology byTortora Grabowski. Palmetto, GA, U.S.A. 6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi. 7. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA 8. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A. 9. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata	
	Course Outcomes (Students will be able to…..)	
CO1	Explain the gross morphology, structure and functions of various organs of the human body.	
CO2	Describe the various homeostatic mechanisms and their imbalances	
CO3	Appreciate coordinated working pattern of different organs of each system	
C04	Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1129	Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)	Credits= 4		
	Semester: II	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

HSC (Chemistry)

List of Courses where this course will be Prerequisite

Pharmaceutical organic chemistry –II (theory), Pharmaceutical organic chemistry –I (practical)

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences	
1	**UNIT-I** **Classification, nomenclature and isomerism** Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds	07 Hours
2	**UNIT-II** **Alkanes*, Alkenes* and Conjugated dienes***	10 Hours

	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	
3	**UNIT-III** **Alkyl halides*** SN_1 and SN_2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN_1 versus SN_2 reactions, Factors affecting SN_1 and SN_2 reactions Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*-** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol	10 Hours
4	**UNIT-IV** **Carbonyl compounds* (Aldehydes and ketones)** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.	10 Hours
5	**UNIT-V** **Carboxylic acids*** Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid **Aliphatic amines* -** Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine	08 Hours

	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	
CO1	Write the structure, name and the type of isomerism of the organic compound	
CO2	Write the reaction, name the reaction and orientation of reactions	
CO3	Account for reactivity/stability of compounds	
C04	Identify/confirm the identification of organic compound	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1130	Course Title: BIOCHEMISTRY (Theory)	Credits= 4		
	Semester : II	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

HSC (Biology)

List of Courses where this course will be Prerequisite

Biochemistry (Practical), Medicinal Chemistry- I, Pharmacology-I, Pharmaceutical Biotechnology

Description of relevance of this course in the B. Pharm Programme

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.

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT I** **Biomolecules** Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins. **Bioenergetics** Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential. Energy rich compounds; classification; biological significances of ATP and cyclic AMP	08 Hours
2	**UNIT II** **Carbohydrate metabolism**	10 Hours

	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	
3	**UNIT III** **Lipid metabolism** β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism** General reactions of amino acid metabolism Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice	10 Hours

4	**UNIT IV** **Nucleic acid metabolism and genetic information transfer** Biosynthesis of purine and pyrimidine nucleotides Catabolism of purine nucleotides and Hyperuricemia and Gout disease Organization of mammalian genome Structure of DNA and RNA and their functions DNA replication (semi conservative model) Transcription or RNA synthesis Genetic code, Translation or Protein synthesis and inhibitors	10 Hours
5	**UNIT V** **Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Line Weaver Burke plot) Enzyme inhibitors with examples Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes –Structure and biochemical functions	07 Hours
	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	

CO1	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	
CO2	Understand 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.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1131	Course Title: PATHOPHYSIOLOGY (THEORY)	Credits= 4		
	Semester: II	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Human Anatomy and Physiology I and II, Biochemistry (Theory)

List of Courses where this course will be Prerequisite

Pharmacology I, Medicinal Chemistry I, Pharmaceutical technology, clinical Pharmacology

Description of relevance of this course in the B. Pharm Programme

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.

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
3. Mention the complications of the diseases

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury**,** Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage)**,** Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia)**,**Cell swelling, Intra cellular accumulation,Calcification, Enzyme leakage and Cell Death, Acidosis &Alkalosis, Electrolyte imbalance **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	10 Hours

2	**Unit II** **Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, Chronic obstructive airways diseases. **Renal system:** Acute and chronic renal failure .	10 Hours
3	**Unit II** **Haematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones **Nervous system:** Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Gastrointestinal system:** Peptic Ulcer	10 Hours
4	**Unit IV** Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout **Principles of cancer:** classification, etiology and pathogenesis of cancer **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer	08 Hours
5	**Unit V** **Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections **Sexually transmitted diseases:** AIDS, Syphilis, Gonorrhea	07 Hours
	List of Text Book/ Reference Books	
	1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014. 2. Harsh Mohan; Text book of Pathology; 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.
11. The Journal of Pathology. ISSN: 1096-9896 (Online)
12. The American Journal of Pathology. ISSN: 0002-9440
13. Pathology. 1465-3931 (Online)
14. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
15. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

	Course Outcomes (Students will be able to…..)	
CO1	Describe the etiology and pathogenesis of the selected disease states	
CO2	Name the signs and symptoms of the diseases	
CO3	Mention the complications of the diseases	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1132	Course Title: COMPUTER APPLICATIONS IN PHARMACY (Theory)	Credits= 3		
	Semester : II	Total Contact Hours: 45	L	T	P
			3	-	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All subjects

Description of relevance of this course in the B. Pharm Programme

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT – I** **Number system**: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement , Two's complement method, binary multiplication, binary division **Concept of Information Systems and Software :** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project	06 hours
2	**UNIT –II** **Web technologies**: Introduction to HTML, XML,CSS and	06 hours

	Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database	
3	**UNIT III** **Application of computers in Pharmacy** – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge (EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System	06 hours
4	**UNIT – IV** **Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	06 hours
5	**UNIT-V** **Computers as data analysis in Preclinical development**: Chromatographic dada analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)	06 hours
	List of Text Book/ Reference Books	
	1. Computer Application in Pharmacy – William E.Fassett – Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330. 2. Computer Application in Pharmaceutical Research and Development – Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA 3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi- CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA) 4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002	
	Course Outcomes (Students 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 applications of databases in pharmacy	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: HUT1114	Course Title: ENVIRONMENTAL SCIENCES (Theory)	Credits= 3		
	Semester : II	Total Contact Hours: 45	L	T	P
			3	-	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All subjects

Description of relevance of this course in the B. Pharm Programme

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.

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit-I** The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.	10 hours
2	**Unit-II** Ecosystems Concept of an ecosystem. Structure and function of an ecosystem.	10 hours

	Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
3	**Unit- III** Environmental Pollution: Air pollution; Water pollution; Soil pollution	10 hours
	List of Text Book/ Reference Books	
	1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore 2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. 3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India, 4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p 5. Clark R.S., Marine Pollution, Clanderson Press Oxford 6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p 7. De A.K., Environmental Chemistry, Wiley Eastern Ltd. 8. Down of Earth, Centre for Science and Environment	
	Course Outcomes (Students 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.	
C04	Acquire skills to help the concerned individuals in identifying and solving environmental problems	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3, A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1133	Course Title: HUMAN ANATOMY AND PHYSIOLOGY (Practical)	Credits= 2		
	Semester: II	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Human anatomy and physiology I and II (Theory)

List of Courses where this course will be Prerequisite

Pharmacology (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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. Appreciate coordinated working pattern of different organs of each system
5. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.** 1. 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.	
	List of Text Book/ Reference Books	
	1. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 2. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi. 3. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi. 4. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi 5. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA 6. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A. 7. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata	
	Course Outcomes (Students will be able to…..)	
CO1	Explain the gross morphology, structure and functions of various organs of the human body.	
CO2	Identify the various tissues and organs of different systems of human body.	
CO3	Perform the haematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**

		1	2	3	4	5	6	7	8	9	10	11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
CO4	K3	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1134	Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)	Credits= 2		
	Semester : II	**Total Contact Hours: 60**	**L**	**T**	**P**
			-	-	4

List of Prerequisite Courses

Pharmaceutical organic chemistry -I (theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry I (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
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 analyzed systematically.	
2	Preparation of suitable solid derivatives from organic compounds	
3	Construction of molecular models	
	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	
CO1	Write the structure, name and the type of isomerism of the organic compound	
CO2	Write the reaction, name the reaction and orientation of reactions	
CO3	Account for reactivity/stability of compounds,	
C04	Identify/confirm the identification of organic compound	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
CO4	K3	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1135	Course Title: BIOCHEMISTRY (Practical)	Credits= 2		
	Semester : II	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Biochemistry (Theory)

List of Courses where this course will be Prerequisite

Medicinal chemistry (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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.	
	List of Text Book/ Reference Books	
	1. Practical Biochemistry by R.C. Gupta and S. Bhargavan. 2. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition) 3. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna. 4. Practical Biochemistry by Harold Varley. 5. Principles of Biochemistry by Lehninger. 6. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell. 7. Biochemistry by Stryer. 8. Biochemistry by D. Satyanarayan and U.Chakrapani	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.	
CO2	Understand 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	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
CO4	K3	3	2	2	3	2	2	2	2	2	2	2
Course	K3	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1136	**Course Title:** COMPUTER APPLICATIONS IN PHARMACY (Practical)	**Credits= 1**		
	Semester: II	**Total Contact Hours: 30**	**L**	**T**	**P**
			-	-	2

List of Prerequisite Courses

Computer applications in pharmacy (Theory)

List of Courses where this course will be Prerequisite

All subjects

Description of relevance of this course in the B. Pharm Programme

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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	
	List of Text Book/ Reference Books	
	1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330. 2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA 3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi- CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA) 4. Microsoft office Access – 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002	
	Course Outcomes (Students will be able to…..)	
CO1	Know and use various types of application of computers in pharmacy	
CO2	Know the various types of databases	
CO3	Know and use various applications of databases in pharmacy	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester III

	Course Code: PHT1133	**Course Title:** PHARMACEUTICAL ORGANIC CHEMISTRY – II (Theory)	**Credits= 4**		
	Semester: III	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutical organic chemistry –I (Theory)

List of Courses where this course will be Prerequisite

Pharmaceutical organic chemistry –I (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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, prepare organic compounds

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences	
1	**UNIT I** **Benzene and its derivatives** Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule **Reactions of benzene** – nitration, sulphonation, halogenation- reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction	10 Hours

	Structure and uses of DDT, Saccharin, BHC and Chloramine	
2	**UNIT II** **Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols **Aromatic Amines* -** Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts **Aromatic Acids* –**Acidity, effect of substituents on acidity and important reactions of benzoic acid.	10 Hours
3	**UNIT III** **Fats and Oils** **Fatty acids** – reactions Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. **Analytical constants** – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	10 Hours
4	**UNIT IV** **Polynuclear hydrocarbons:** Synthesis, reactions Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	08 Hours
5	**UNIT V** **Cyclo alkanes*** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and 74acemizatio only	07 Hours
	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	

CO1	Write the structure, name and the type of isomerism of the organic compound	
CO2	Write the reaction, name the reaction and orientation of reactions	
CO3	Account for reactivity/stability of compounds, prepare organic compounds	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	K2	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1134	Course Title: PHYSICAL PHARMACEUTICS-I (Theory)	Credits= 4		
	Semester : III	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmaceutics I (Theory)

List of Courses where this course will be Prerequisite

Physical Pharmaceutics I (Practical)

Description of relevance of this course in the B. Pharm Programme

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

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 nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	10 Hours
2	**UNIT-II** **States of Matter and properties of matter:** State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols– inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid- crystalline, amorphous & polymorphism.	10 Hours

	Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	
3	**UNIT-III** **Surface and interfacial phenomenon:** Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.	10 Hours
4	**UNIT-IV** **Complexation and protein binding:** Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.	08 Hours
5	**UNIT-V** **pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	07 Hours
	List of Text Book/ Reference Books	
	1. Physical Pharmacy by Alfred Martin 2. Experimental Pharmaceutics by Eugene, Parott. 3. Tutorial Pharmacy by Cooper and Gunn. 4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia. 5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc. 6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc. 7. Physical Pharmaceutics by Ramasamy C and ManavalanR. 8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee 9. Physical Pharmaceutics by C.V.S. Subramanyam 10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar	
	Course Outcomes (Students will be able to…..)	

CO1	Understand various physicochemical properties of drug molecules in the designing the dosage forms	
CO2	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations	
CO3	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1135	Course Title: PHARMACEUTICAL MICROBIOLOGY (Theory)	Credits= 4		
	Semester : III	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

HSC (Biology)

List of Courses where this course will be Prerequisite

Pharmaceutical Biotechnology, Medicinal Chemistry I, Pharmacology I

Description of relevance of this course in the B. Pharm Programme

Scope: Study of all categories of microorganisms especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc.

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

1.Understand methods of identification, cultivation and preservation of various microorganisms

2.To understand the importance and implementation of 79acemization79 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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy.	10 Hours
2	**Unit II** Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests	10 Hours

	(IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous,radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods Equipments employed in large scale sterilization. Sterility indicators.	
3	**Unit III** Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.	10 Hours
4	**Unit IV** Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	08 Hours
5	**Unit V** Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research	07 Hours
	List of Text Book/ Reference Books	
	1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology,	

	Blackwell Scientific publications, Oxford London. 2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi. 3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. 4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. 5. Rose: Industrial Microbiology. 6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan 7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution. 8. Peppler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions. 10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai 11. Edward: Fundamentals of Microbiology. 12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi 13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company	
	Course Outcomes (Students will be able to…..)	
CO1	Understand methods of identification, cultivation and preservation of various microorganisms	
CO2	To understand the importance and implementation of 81acemization81 in pharmaceutical processing and industry	
CO3	Learn sterility testing of pharmaceutical products	
C04	Understand the cell culture technology and its applications in pharmaceutical industries.	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1136	Course Title: PHARMACEUTICAL ENGINEERING (Theory)	Credits= 4		
	Semester : III	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutics I (Theory)

List of Courses where this course will be Prerequisite

Industrial Pharmacy I

Description of relevance of this course in the B. Pharm Programme

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

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

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Flow of fluids:** Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer. **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	10 Hours
2	**UNIT-II** **Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. **Evaporation:** Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process.	10 Hours

	Principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator. **Distillation:** Basic Principles and methodology of simple distillation,flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation	
3	**UNIT- III** **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,	08 Hours
4	**UNIT-IV** **Filtration:** Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter. **Centrifugation:** Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.	08 Hours
5	**UNIT- V** **Materials of pharmaceutical plant construction, Corrosion and its prevention:** Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.	07 Hours
	List of Text Book/ Reference Books	

	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.	
	Course Outcomes (Students will be able to…..)	
CO1	To know various unit operations used in pharmaceutical industries.	
CO2	To understand the material handling techniques	
CO3	To appreciate and comprehend significance of plant lay out design for optimum use of resources.	
C04	To appreciate the various preventive methods used for corrosion control in pharmaceutical industries.	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1137	Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY - II (Practical)	Credits= 2		
	Semester : III	**Total Contact Hours: 60**	**L**	**T**	**P**
					4

List of Prerequisite Courses

Pharmaceutical organic chemistry -II (Theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry II (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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

a. write the structure, name and the type of isomerism of the organic compound
b. write the reaction, name the reaction and orientation of reactions
c. account for reactivity/stability of compounds,
d. prepare organic compounds

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	Experiments involving laboratory techniques • **Recrystallization** • **Steam distillation**	
2	Determination of following oil values (including standardization of reagents) • **Acid value** • **Saponification value** • **Iodine value**	
3	**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	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Write the structure, name and the type of isomerism of the organic compound	
CO2	Write the reaction, name the reaction and orientation of reactions	
CO3	Account for reactivity/stability of compounds,	
C04	Prepare organic compounds	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K5	3	2	2	3	2	2	2	1	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1138	**Course Title:** PHYSICAL PHARMACEUTICS – I (Practical)	**Credits= 2**		
	Semester : III	**Total Contact Hours: 60**	**L**	**T**	**P**
			-	-	4

List of Prerequisite Courses

Physical pharmaceutics – I (Theory)

List of Courses where this course will be Prerequisite

Physical Pharmaceutics-II (Theory)

Description of relevance of this course in the B. Pharm Programme

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

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 nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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 char coal	

	9. Determination of critical micellar concentration of surfactants 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method	
	List of Text Book/ Reference Books	
	1. Physical Pharmacy by Alfred Martin 2. Experimental Pharmaceutics by Eugene, Parott. 3. Tutorial Pharmacy by Cooper and Gunn. 4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia. 5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc. 6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc. 7. Physical Pharmaceutics by Ramasamy C and ManavalanR. 8. Laboratory Manual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee 9. Physical Pharmaceutics by C.V.S. Subramanyam 10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar	
	Course Outcomes (Students will be able to…..)	
CO1	Understand various physicochemical properties of drug molecules in designing the dosage forms	
CO2	Know the principles of chemical kinetics & to use them for stability testing nad determination of expiry date of formulations	
CO3	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1139	Course Title: PHARMACEUTICAL MICROBIOLOGY (Practical)	Credits= 2		
	Semester : III	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmaceutical microbiology (Theory)

List of Courses where this course will be Prerequisite

Not Applicable

Description of relevance of this course in the B. Pharm Programme

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

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

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of 91acemization91 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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology. 2. Sterilization of glassware, preparation and sterilization of media. 3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations. 4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical). 5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques. 6. Microbiological assay of antibiotics by cup plate method and other methods 7. Motility determination by Hanging drop method. 8. Sterility testing of pharmaceuticals.	

	9. Bacteriological analysis of water 10. Biochemical test.	
	List of Text Book/ Reference Books	
	1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. 2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi. 3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. 4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. 5. Rose: Industrial Microbiology. 6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan 7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution. 8. Peppler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions. 10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai 11. Edward: Fundamentals of Microbiology. 12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi 13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company	
	Course Outcomes (Students will be able to…..)	
CO1	Understand and perform different methods of identification, cultivation and preservation of various microorganisms	
CO2	Learn sterility testing of pharmaceutical products.	
CO3	Carried out microbiological standardization of Pharmaceuticals	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K5	3	2	2	3	2	2	2	1	2	2	2
CO2	K2	3	2	2	2	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	3	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1140	Course Title: PHARMACEUTICAL ENGINEERING (Practical)	Credits= 2		
	Semester : III	**Total Contact Hours: 60**	**L**	**T**	**P**
			-	-	4

List of Prerequisite Courses

Pharmaceutical engineering (Theory)

List of Courses where this course will be Prerequisite

Industrial Pharmacy I, Novel Drug Delivery Systems

Description of relevance of this course in the B. Pharm Programme

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

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

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 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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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 andlogarithmic probability plots.

IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.

X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such othermajor equipment.

XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity

XII. To study the effect of time on the Rate of Crystallization.

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

List of Text Book/ Reference Books

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

	Course Outcomes (Students will be able to…..)	
CO1	To know various unit operations used in pharmaceutical industries.	
CO2	To understand the material handling techniques.	
CO3	To perform various processes involved in pharmaceutical manufacturing process.	
C04	To carry out various test to prevent environmental pollution.	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	2	2	2	2	2	2	2	2
CO2	K2	3	2	2	2	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
CO4	K5	3	2	2	3	2	2	2	2	3	3	3
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester IV

	Course Code: PHT1137	Course Title: PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)	Credits= 4		
	Semester : IV	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutical organic chemistry –II (Theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry I

Description of relevance of this course in the B. Pharm Programme

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.

Objectives: At the end of the course, the 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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	Note: To emphasize on definition, types, mechanisms, examples, uses/applications	
1	**UNIT-I** **Stereo isomerism** Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers Reactions of chiral molecules Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute	10 Hours

2	**UNIT-II** Geometrical isomerism Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions	10 Hours
3	**UNIT-III** **Heterocyclic compounds:** Nomenclature and classification Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene	10 Hours
4	**UNIT-IV** Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives	08 Hours
5	**UNIT-V** **Reactions of synthetic importance** Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen Schmidt condensation	07 Hours

	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the methods of preparation and properties of organic compounds	
CO2	Explain the stereo chemical aspects of organic compounds and stereo chemical reactions	
CO3	Know the medicinal uses and other applications of organic compounds	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1138	Course Title: MEDICINAL CHEMISTRY – I (Theory)	Credits= 4		
	Semester : IV	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutical Organic Chemistry II (theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry I (Practical), Medicinal Chemistry II (Theory)

Description of relevance of this course in the B. Pharm Programme

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.

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 (SAR) of different class of drugs
4. write the chemical synthesis of some drugs

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)	
1	**UNIT- I** **Introduction to Medicinal Chemistry** **History and development of medicinal chemistry** **Physicochemical properties in relation to biological action** Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.	**10 Hours**

	Drug metabolism Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.	
2	**UNIT- II** **Drugs acting on Autonomic Nervous System Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution. **Sympathomimetic agents**: SAR of Sympathomimetic agents Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. **Indirect acting agents**: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine. **Agents with mixed mechanism**: Ephedrine, Metaraminol. **Adrenergic Antagonists:** **Alpha adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. **Beta adrenergic blockers:** SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.	10 Hours
3	**UNIT-III** **Cholinergic neurotransmitters:** Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. Parasympathomimetic agents: SAR of Parasympathomimetic agents **Direct acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. **Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.	10 Hours

	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.	
4	**UNIT- IV** **Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics:** **Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem **Barbiturtes:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital **Miscelleneous:** Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. **B. Antipsychotics** **Phenothiazeines:** SAR of Phenothiazeines – Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. **Ring Analogues of Phenothiazeines:** Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. **Fluro buterophenones:** Haloperidol, Droperidol, Risperidone. **Beta amino ketones:** Molindone hydrochloride. **Benzamides:** Sulpieride.	08 Hours

	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	
5	**UNIT – V** **Drugs acting on Central Nervous System** **General anesthetics:** **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short acting barbitutrates:** Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride.* **Narcotic and non-narcotic analgesics** **Morphine and related drugs:** SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. **Anti-inflammatory agents:** Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.	07 Hours

	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the chemistry of drugs with respect to their pharmacological activity	
CO2	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	
CO3	Know the Structural Activity Relationship (SAR) of different class of drugs	
C04	Write the chemical synthesis of some drugs	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1139	Course Title: PHYSICAL PHARMACEUTICS-II (Theory)	**Credits= 4**		
	Semester : IV	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Physical pharmaceutics-I (Theory)

List of Courses where this course will be Prerequisite

Physical pharmaceutics-II (Practical), Industrial Pharmacy I

Description of relevance of this course in the B. Pharm Programme

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

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 nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Colloidal dispersions:** Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action.	07 Hours
2	**UNIT-II** **Rheology:** Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers **Deformation of solids:** Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus	10 Hours

3	**UNIT-III** **Coarse dispersion:** Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.	10 Hours
4	**UNIT-IV** **Micromeretics:** Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	10 Hours
5	**UNIT-V** **Drug stability:** Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention	10 Hours
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	

CO1	Understand various physicochemical properties of drug molecules in the designing the dosage forms	
CO2	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations	
CO3	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1140	Course Title: PHARMACOLOGY-I (Theory)	Credits= 4		
	Semester : IV	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Human Anatomy and Physiology I and II, Pathophysiology

List of Courses where this course will be Prerequisite

Pharmacology I (Practical), Pharmacology II, Pharmacology III

Description of relevance of this course in the B. Pharm Programme

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.

Objectives: Upon completion of this course the student should 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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **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	08 hours
2	**UNIT-II**	12 Hours

	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.	
3	**UNIT-III** **Pharmacology of drugs acting on peripheral nervous system** c. Organization and function of ANS. b.Neurohumoral transmission,co-transmission and classification of neurotransmitters. c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). e. Local anesthetic agents. f. Drugs used in myasthenia gravis and glaucoma	10 Hours
4	**UNIT-IV** **Pharmacology of drugs acting on central nervous system** a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anesthetics and pre-anesthetics**.** c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics e. Alcohols and disulfiram	08 Hours

5	**UNIT-V** **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	07 Hours
	List of Text Book/ Reference Books	
	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. VallabhPrakashan	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the pharmacological actions of different categories of drugs	
CO2	Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.	
CO3	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases	

C04	Appreciate correlation of pharmacology with other bio medical sciences	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1141	Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)	Credits= 4		
	Semester : IV	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

HSC (Biology), Remedial Biology

List of Courses where this course will be Prerequisite

Pharmacognosy and phytochemistry I (Practical), Pharmacognosy and phytochemistry II

Description of relevance of this course in the B. Pharm Programme

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.

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	10 Hours

2	**UNIT-II** **Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants **Conservation of medicinal plants**	10 Hours
3	**UNIT-III** **Plant tissue culture:** Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines	07 Hours
4	**UNIT IV** **Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	10 Hours
5	**UNIT V** Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers – Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and	08 Hours

	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	
	List of Text Book/ Reference Books	
	1. .C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009. 2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988. 3. Text Book of Pharmacognosy by T.E. Wallis 4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi. 5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi. 6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi. 7. Essentials of Pharmacognosy, Dr.SH.Ansari, Iind edition, Birla publications, New Delhi, 2007	
	Course Outcomes (Students will be able to…..)	
CO1	Know the techniques in the cultivation and production of crude drugs	
CO2	Know the crude drugs, their uses and chemical nature	
CO3	Know the evaluation techniques for the herbal drugs	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	K2	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1141	Course Title: MEDICINAL CHEMISTRY – I (Practical)	Credits= 2		
	Semester : IV	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Medicinal Chemistry I (Theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry II (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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 (SAR) of different class of drugs
4. write the chemical synthesis of some drugs

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**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	
2	**II Assay of drugs** 1 Chlorpromazine 2 Phenobarbitone 3 Atropine 4 Ibuprofen 5 Aspirin 6 Furosemide	
3	Determination of Partition coefficient for any two drugs	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Write and perform the chemical synthesis of some drugs	
CO2	Understand and perform assays of drugs	
CO3	Determine partition coefficient of drugs	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K5	3	2	2	3	2	2	2	2	2	2	2
CO2	K5	3	2	2	3	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
Course	K5	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1142	Course Title: PHYSICAL PHARMACEUTICS- II (Practical)	Credits= 2		
	Semester : IV	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Physical Pharmaceutics I (Practical), Physical Pharmaceutics II (Theory)

List of Courses where this course will be Prerequisite

Industrial Pharmacy

Description of relevance of this course in the B. Pharm Programme

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

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 nad determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand various physicochemical properties of drug molecules in the designing the dosage forms	
CO2	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations	
CO3	Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1143	**Course Title:** PHARMACOLOGY-I (Practical)	**Credits= 2**		
	Semester : IV	**Total Contact Hours: 60**	**L**	**T**	**P**
			-	-	4

List of Prerequisite Courses

Pharmacology I (Theory)

List of Courses where this course will be Prerequisite

Pharmacology II, Pharmacology III

Description of relevance of this course in the B. Pharm Programme

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.

Objectives: Upon completion of this course the student should 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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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

List of Text Book/ Reference Books

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. VallabhPrakashan,

	Course Outcomes (Students will be able to…..)	
CO1	Observe the effect of drugs on animals by simulated experiments	
CO2	Understand the pharmacological actions of different categories of drugs	
CO3	Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K2	3	2	2	2	2	2	2	2	2	2	2
CO3	K2	3	2	2	2	2	2	2	2	2	2	2
Course	**K3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1144	Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)	Credits= 2		
	Semester : IV	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmacognosy and phytochemistry I (Theory)

List of Courses where this course will be Prerequisite

Pharmacognosy and phytochemistry II, Herbal Drug Technology

Description of relevance of this course in the B. Pharm Programme

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.

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	1. Analysis of crude drugs by chemical tests: (i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil 2. Determination of stomatal number and index 3. Determination of vein islet number, vein islet termination and 123acemiza 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	
	List of Text Book/ Reference Books	
	1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009. 2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988. 3. Text Book of Pharmacognosy by T.E. Wallis 4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi. 5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi. 6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi. 7. Essentials of Pharmacognosy, Dr.SH.Ansari, Iind edition, Birla publications, New Delhi, 2007 8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae 9. Anatomy of Crude Drugs by M.A. Iyengar	
	Course Outcomes (Students will be able to…..)	
CO1	Carry out the microscopic and morphological evaluation of crude drugs	
CO2	Know the evaluation techniques for the herbal drugs	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K5	3	2	2	3	2	2	2	2	2	2	2
CO2	K5	3	2	2	3	2	2	2	2	2	2	2
Course	K5	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester V

	Course Code: PHT1142	Course Title: MEDICINAL CHEMISTRY – II (Theory)	Credits= 4		
	Semester : V	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Medicinal Chemistry I (Theory)

List of Courses where this course will be Prerequisite

Medicinal Chemistry II (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)	
1	**UNIT- I** **Antihistaminic agents:** Histamine, receptors and their distribution in the humanbody **H_1–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	10 Hours

	hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium **H_2-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.	
2	**UNIT – II** **Anti-anginal**: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics:** Carbonic anhydrase inhibitors: Acetazolamide*, Methazolam ide, Dichlorphenamide. Thiazides: Chlorthiazide*,Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol **Anti-hypertensive Agents**: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.	10 Hours

3	**UNIT- III** **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.	10 Hours
4	**UNIT- IV** **Drugs acting on Endocrine system** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones**: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethas one, Dexamethasone **Thyroid and antithyroid drugs**: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	08 Hours
5	UNIT – V **Antidiabetic agents:** Insulin and its preparations Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide.	07 Hours

	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.*	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the chemistry of drugs with respect to their pharmacological activity	
CO2	Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs	
CO3	Know the Structural Activity Relationship of different class of drugs	
C04	Study the chemical synthesis of selected drugs	

Mapping of Course Outcomes (Cos) with Programme Outcomes (Pos)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1143	Course Title: INDUSTRIAL PHARMACY I (THEORY)	Credits= 4		
	Semester : V	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmaceutics I, Physical Pharmaceutics

List of Courses where this course will be Prerequisite

Industrial Pharmacy II

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. ***a. Physical properties:*** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism ***b. Chemical Properties:*** Hydrolysis, oxidation, reduction, 131acemization, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	07 Hours
2	**UNIT-II** **Tablets:**	10 Hours

	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	
3	**UNIT-III** **Capsules:** a. ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. b. ***Soft gelatin capsules:*** Nature of shell and capsule content, size of capsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications. **Pellets:** Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets	08 Hours
4	**UNIT-IV** **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	10 Hours

5	**UNIT-V** **Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.	10 Hours
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Know the basics of various pharmaceutical dosage forms and their manufacturing techniques.	
CO2	Understand considerations in development of pharmaceutical dosage forms	
CO3	Know techniques of evaluation of solid, liquid and semisolid dosage forms to ensure their quality	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	2	1	1	3	3	3	3	3
CO2	K2	3	2	2	2	1	1	3	3	3	3	3
CO3	K2	3	2	2	2	1	1	3	3	3	3	3
Course	**K2**	3	2	2	2	**1**	**1**	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1144	Course Title: PHARMACOLOGY-II (Theory)	Credits= 4		
	Semester : V	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmacology I

List of Courses where this course will be Prerequisite

Pharmacology II (Practical), Pharmacology III

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Pharmacology of drugs acting on cardio vascular system** a. Introduction to hemodynamic and electrophysiology of heart. b. Drugs used in congestive heart failure c. Anti-hypertensive drugs. d. Anti-anginal drugs. e. Anti-arrhythmic drugs. f. Anti-hyperlipidemic drugs.	10 hours
2	UNIT-II **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	10 hours

	Pharmacology of drugs acting on urinary system e. Diuretics f. Anti-diuretics.	
3	**UNIT-III** **Autocoids and related drugs** a. Introduction to autacoids and classification b. Histamine, 5-HT and their antagonists. c. Prostaglandins, Thromboxanes and Leukotrienes. d. Angiotensin, Bradykinin and Substance P. e. Non-steroidal anti-inflammatory agents f. Anti-gout drugs g. Antirheumatic drugs	10 hours
4	**UNIT-IV** **Pharmacology of drugs acting on endocrine system** a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones- analogues and their inhibitors. c. Thyroid hormones- analogues and their inhibitors. d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. d. Insulin, Oral Hypoglycemic agents and glucagon. e. ACTH and corticosteroids.	08 hours
5	**UNIT-V** **Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. **Bioassay** a. Principles and applications of bioassay. b. Types of bioassay Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT	07 hours
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the mechanism of drug action and its relevance in the treatment of different diseases	
CO2	Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments	
CO3	Demonstrate the various receptor actions using isolated tissue preparation	
C04	Appreciate correlation of pharmacology with related medical sciences	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1145	Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)	Credits= 4		
	Semester: V	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmacognosy and Phytochemistry I

List of Courses where this course will be Prerequisite

Pharmacognosy and Phytochemistry II (Practical)

Description of relevance of this course in the B. Pharm Programme

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Metabolic pathways in higher plants and their determination** a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation ofBiogenetic studies.	07 Hours
2	**UNIT-II** General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:	14 Hours

	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	
3	**UNIT-III** Isolation, Identification and Analysis of Phytoconstituents a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrhetinic acid & Rutin c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine d) Resins: Podophyllotoxin, Curcumin	06 Hours
4	**UNIT-IV** Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	10 Hours
5	**UNIT V** **Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	08 Hours
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents	
CO2	Understand the preparation and development of herbal formulation.	
CO3	Understand the herbal drug interactions	
C04	Carryout isolation and identification of phytoconstituents	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1146	Course Title: PHARMACEUTICAL JURISPRUDENCE (Theory)	Credits= 4		
	Semester : V	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All subjects

Description of relevance of this course in the B. Pharm Programme

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Drugs and Cosmetics Act, 1940 and its rules 1945:** Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.** Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.	10 Hours
2	**UNIT-II** **Drugs and Cosmetics Act, 1940 and its rules 1945.** Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties	10 Hours

	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	
3	**UNIT-III** **Pharmacy Act –1948**: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and 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	10 Hours
4	**UNIT-IV** **Study of Salient Features of Drugs and Magic Remedies Act and its rules:** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties **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)	08 Hours

5	**UNIT-V** **Pharmaceutical Legislations –** A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee **Code of Pharmaceutical ethics** D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath **Medical Termination of Pregnancy Act** **Right to Information Act** **Introduction to Intellectual Property Rights (IPR)**	07 Hours
	List of Text Book/ Reference Books	
	1. Forensic Pharmacy by B. Suresh 2. Text book of Forensic Pharmacy by B.M. Mithal 3. Hand book of drug law-by M.L. Mehra 4. A text book of Forensic Pharmacy by N.K. Jain 5. Drugs and Cosmetics Act/Rules by Govt. of India publications. 6. Medicinal and Toilet preparations act 1955 by Govt. of India publications. 7. Narcotic drugs and psychotropic substances act by Govt. of India publications 8. Drugs and Magic Remedies act by Govt. of India publication 9.Bare Acts of the said laws published by Government. Reference books (Theory)	
	Course Outcomes (Students will be able to…..)	
CO1	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.	
CO2	Various Indian pharmaceutical Acts and Laws	
CO3	The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	
C04	The code of ethics during the pharmaceutical practice	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1145	Course Title: INDUSTRIAL PHARMACY I (PRACTICAL)	Credits= 2		
	Semester : V	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Industrial Pharmacy I (Theory)

List of Courses where this course will be Prerequisite

Industrial Pharmacy II

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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. Qulaity control test of (as per IP) marketed tablets and capsules 9. Preparation of Eye drops/ and Eye ointments 10. Preparation of Creams (cold / vanishing cream) 11. Evaluation of Glass containers (as per IP)	
	List of Text Book/ Reference Books	

	1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz 2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman 3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman 4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition 5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS) 6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman 7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition 8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005 9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.	
	Course Outcomes (Students will be able to…..)	
CO1	Know the various pharmaceutical dosage forms and their manufacturing techniques.	
CO2	Know various considerations in development of pharmaceutical dosage forms	
CO3	Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K3	3	2	2	2	2	2	2	2	2	2	2
CO2	K3	3	2	2	2	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1146	Course Title: PHARMACOLOGY-II (Practical)	Credits= 2		
	Semester : V	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmacology I (theory), Pharmacology II (theory)

List of Courses where this course will be Prerequisite

Pharmacology III (Theory and Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	1. Introduction to *in-vitro* pharmacology and physiological salt solutions. 2. Effect of drugs on isolated frog heart. 3. Effect of drugs on blood pressure and heart rate of dog. 4. Study of diuretic activity of drugs using rats/mice. 5. DRC of acetylcholine using frog rectus abdominis muscle. 6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively. 7. Bioassay of histamine using guinea pig ileum by matching method. 8. Bioassay of oxytocin using rat uterine horn by interpolation method. 9. Bioassay of serotonin using rat fundus strip by three point bioassay. 10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay. 11. Determination of PA_2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).	

	12. Determination of PD_2 value using guinea pig ileum. 13. Effect of spasmogens and spasmolytics using rabbit jejunum. 14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model. 15. Analgesic activity of drug using central and peripheral methods *Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos*	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the mechanism of drug action and its relevance in the treatment of different diseases	
CO2	Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments	

CO3	Demonstrate the various receptor actions using isolated tissue preparation	
C04	Appreciate correlation of pharmacology with related medical sciences	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	2	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
CO4	K2	3	2	2	2	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1147	Course Title: PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)	Credits= 2		
	Semester : V	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmacognosy and phytochemistry II (Theory)

List of Courses where this course will be Prerequisite

Herbal Drug technology

Description of relevance of this course in the B. Pharm Programme

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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	
	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents	
CO2	Understand the preparation and development of herbal formulation	
CO3	Understand the herbal drug interactions	
C04	Carryout isolation and identification of phytoconstituents	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	2	2	2	2	2	2	2	2
CO2	K2	3	2	2	2	2	2	2	2	2	2	2
CO3	K2	3	2	2	2	2	2	2	2	2	2	2
CO4	K5	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester VI

	Course Code: PHT1147	Course Title: MEDICINAL CHEMISTRY – III (Theory)	Credits= 4		
	Semester : VI	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Medicinal Chemistry II

List of Courses where this course will be Prerequisite

Medicinal Chemistry III (Practical), CADD

Description of relevance of this course in the B. Pharm Programme

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.

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)	
1	**UNIT I** **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	**10 Hours**

	Tetracyclines: Tetracycline,Oxytetracycline,Chlortetracycline, Minocycline, Doxycycline	
2	**UNIT II** **Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. **Macrolide:** Erythromycin Clarithromycin, Azithromycin. **Miscellaneous:** Chloramphenicol*, Clindamycin. **Prodrugs:** Basic concepts and application of prodrugs design. **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.	10 Hours
3	**UNIT – III** **Anti-tubercular Agents** **Synthetic anti tubercular agents:** Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti-tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate. **Urinary tract anti-infective agents** **Quinolones:** SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine. **Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.	10 Hours

4	**UNIT – IV** **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*.	08 Hours
5	**UNIT – V** **Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques. **Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.	07 Hours

	List of Text Book/ Reference Books	
	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.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the importance of drug design and different techniques of drug design.	
CO2	Understand the chemistry of drugs with respect to their biological activity.	
CO3	Know the metabolism, adverse effects and therapeutic value of drugs	
C04	Know the importance of SAR of drugs.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1148	Course Title: PHARMACOLOGY-III (Theory)	Credits= 4		
	Semester : VI	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmacology I and II

List of Courses where this course will be Prerequisite

Pharmacology III (Practical)

Description of relevance of this course in the B. Pharm Programme

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.

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 poisoningsand
3. appreciate correlation of pharmacology with related medical sciences.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Pharmacology of drugs acting on Respiratory system** a. Anti -asthmatic drugs b. Drugs used in the management of COPD c. Expectorants and antitussives d. Nasal decongestants e. Respiratory stimulants **Pharmacology of drugs acting on the Gastrointestinal Tract** f. Antiulcer agents. g. Drugs for constipation and diarrhoea. h. Appetite stimulants and suppressants. i. Digestants and carminatives. j. Emetics and anti-emetics.	10 hours
2	**UNIT-II** **Chemotherapy** a. General principles of chemotherapy.	10 hours

	b. Sulfonamides and cotrimoxazole. c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides	
3	**UNIT-III** **Chemotherapy** a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Anti- viral drugs. e. Anthelmintics f. Antimalarial drugs g. Antiamoebic agents	10 hours
4	**UNIT-IV** **Chemotherapy** a. Urinary tract infections and sexually transmitted diseases. b. Chemotherapy of malignancy. **Immunopharmacology** a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	08 hours
5	**UNIT-V** **Principles of toxicology** a. Definition and basic knowledge of acute, subacute and chronic toxicity. b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning. **Chronopharmacology** e. Definition of rhythm and cycles. Biological clock and their significance leading to chronotherapy	07 hours
	List of Text Book/ Reference Books	

	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,	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases	
CO2	Comprehend the principles of toxicology and treatment of various poisoning	
CO3	Appreciate correlation of pharmacology with related medical sciences.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	K2	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1149	Course Title: HERBAL DRUG TECHNOLOGY (Theory)	Credits= 4		
	Semester : VI	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmacognosy and Phytochemistry II

List of Courses where this course will be Prerequisite

Herbal Drug Technology (Practical)

Description of relevance of this course in the B. Pharm Programme

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

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 .

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Herbs as raw materials** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material **Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. **Indian Systems of Medicine** a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma.	11 Hours
2	**UNIT-II**	07 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.	
3	**UNIT-III** **Herbal Cosmetics** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. **Herbal excipients:** Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. **Herbal formulations :** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes	10 Hours
4	**UNIT- IV** **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	10 Hours

5	**UNIT-V** **General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India. **Schedule T – Good Manufacturing Practice of Indian systems of medicine** Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.	07 Hours
	List of Text Book/ Reference Books	
	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	
	Course Outcomes (Students will be able to…..)	
CO1	Understand raw material as source of herbal drugs from cultivation to herbal drug product	
CO2	Know the WHO and ICH guidelines for evaluation of herbal drugs	
CO3	Know the herbal cosmetics, natural sweeteners, nutraceuticals	
C04	Appreciate patenting of herbal drugs, GMP .	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1150	Course Title: BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)	Credits= 4		
	Semester : VI	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutics I, Industrial Pharmacy I, Pharmacology I

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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.

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.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Introduction to Biopharmaceutics** **Absorption**: Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution:** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs	10 Hours
2	**UNIT- II** **Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of	10 Hours

	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.	
3	**UNIT- III** **Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - K_E ,t1/2,Vd,AUC,Ka, Clt and CL_R- definitions methods of eliminations, understanding of their significance and application	10 Hours
4	**UNIT- IV** **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.	08 Hours
5	**UNIT- V** **Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing non-linearity. c. Michaelis-Menton method of estimating parameters, Explanation with example of drugs.	07 Hours
	List of Text Book/ Reference Books	
	1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi. 2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari 3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA 4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi 5. Pharmacokinetics: By Milo Glbaldi Donald, R. Mercel Dekker Inc. 6. Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and	

	Laurie Prescott by ADIS Health Science Press. 7. Biopharmaceutics; By Swarbrick 8. Clinical Pharmacokinetics, Concepts and Applications: By Malcolm Rowland and 9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995. 10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company,Pennsylvania 1989. 11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987. 12. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvnia	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.	
CO2	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.	
CO3	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.	
C04	Understand various pharmacokinetic parameters, their significance & applications.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1151	Course Title: PHARMACEUTICAL BIOTECHNOLOGY (Theory)	Credits= 4		
	Semester : VI	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmaceutical Microbiology, Biochemistry

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. b) Enzyme Biotechnology- Methods of enzyme immobilization and applications. c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries. d) Brief introduction to Protein Engineering. e) Use of microbes in industry. Production of Enzymes- General	10 Hours

	consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. f) Basic principles of genetic engineering.	
2	**Unit II** a) Study of cloning vectors, restriction endonucleases and DNA ligase. b) Recombinant DNA technology. Application of genetic engineering in medicine. c) Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. d) Brief introduction to PCR	10 Hours
3	**Unit III** Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications g) Blood products and Plasma Substituties.	10 Hours
4	**Unit IV** a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting. b) Genetic organization of Eukaryotes and Prokaryotes c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. d) Introduction to Microbial biotransformation and applications. e) Mutation: Types of mutation/mutants.	08 Hours
5	**Unit V** a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.	07 Hours

	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.	
	List of Text Book/ Reference Books	
	1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C. 2. RA Goldshy et. al., Kuby Immunology. 3. J.W. Goding: Monoclonal Antibodies. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry. 4. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio. 5. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication. 6. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi	
	Course Outcomes (Students will be able to…..)	
CO1	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries	
CO2	Genetic engineering applications in relation to production of pharmaceuticals	
CO3	Importance of Monoclonal antibodies in Industries	
C04	Appreciate the use of microorganisms in fermentation technology	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1152	Course Title: PHARMACEUTICAL QUALITY ASSURANCE (Theory)	Credits= 4		
	Semester : VI	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

All subjects

Description of relevance of this course in the B. Pharm Programme

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.

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT – I** **Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP **Total Quality Management (TQM):** Definition, elements, philosophies **ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines **Quality by design (QbD)**: Definition, overview, elements of QbD program, tools **ISO 9000 & ISO14000**: Overview, Benefits, Elements, steps for registration **NABL accreditation** : Principles and procedures	10 Hours

2	**UNIT – II** **Organization and personnel:** Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipments and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	10 Hours
3	**UNIT – III** **Quality Control:** Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities	10 Hours
4	**UNIT IV** **Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	08 Hours
5	**UNIT – V** **Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management	07 Hours
	List of Text Book/ Reference Books	
	1. Quality Assurance Guide by organization of Pharmaceutical Products of India. 2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69. 3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications. 4. A guide to Total Quality Management- Kushik Maitra and Sedhan K	

	Ghosh 5. How to Practice GMP's – P P Sharma. 6. ISO 9000 and Total Quality Management – Sadhank G Ghosh 7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms 8. Good laboratory Practices – Marcel Deckker Series 9. ICH guidelines, ISO 9000 and 14000 guidelines	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the cGMP aspects in a pharmaceutical industry	
CO2	Appreciate the importance of documentation	
CO3	Understand the scope of quality certifications applicable to pharmaceutical industries	
C04	Understand the responsibilities of QA & QC departments	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1148	Course Title: MEDICINAL CHEMISTRY- III (Practical)	Credits= 2		
	Semester : VI	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Medicinal Chemistry III (Theory)

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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.

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 and perform the synthesis of drugs.
3. Perform assays for different drugs.
4. Experimentally determine the physico-chemical properties of drugs.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Preparation of drugs and intermediates** 1 Sulphanilamide 2 7-Hydroxy, 4-methyl coumarin 3 Chlorobutanol 4 Triphenyl imidazole 5 Tolbutamide 6 Hexamine	
2	**Assay of drugs** 1 Isonicotinic acid hydrazide 2 Chloroquine	

	3 Metronidazole 4 Dapsone 5 Chlorpheniramine maleate 6 Benzyl penicillin	
3	Preparation of medicinally important compounds or intermediates by Microwave irradiation technique	
4	Drawing structures and reactions using chemdraw®	
5	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)	
	List of Text Book/ Reference Books	
	1. Organic Chemistry by I.L. Finar, Vol. II. 2. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5. 3. Indian Pharmacopoeia. 4. Text book of practical organic chemistry- A.I.Vogel. 5. Introduction to principles of drug design- Smith and Williams. 6. Remington's Pharmaceutical Sciences. 7. Martindale's extra pharmacopoeia. 8. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry. 9. Foye's Principles of Medicinal Chemistry. 10. Burger's Medicinal Chemistry, Vol I to IV.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the importance of drug design and different techniques of drug design.	
CO2	Understand and perform the synthesis of drugs.	
CO3	Perform assays for different drugs	
C04	Experimentally determine the physico-chemical properties of drugs.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	2	2	2	2	2	2	2	2
CO2	K5	3	2	2	3	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
CO4	K5	3	2	2	3	2	2	2	2	2	2	2
Course	**K5**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1149	Course Title: PHARMACOLOGY-III (Practical)	Credits= 2		
	Semester : VI	Total Contact Hours: 60	L	T	P
			-	-	4

List of Prerequisite Courses

Pharmacology III (Theory)

List of Courses where this course will be Prerequisite

Experimental Pharmacology

Description of relevance of this course in the B. Pharm Programme

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.

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 poisoningsand
3. appreciate correlation of pharmacology with related medical sciences.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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*	
	List of Text Book/ Reference Books	
	1. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata, 2. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan, 3. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology. 4. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier 5. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill 6. Goodman and Gilman's, The Pharmacological Basis of Therapeutics 7. 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 8. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology 9. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi. 10. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases	
CO2	Comprehend the principles of toxicology and treatment of various poisonings	
CO3	Appreciate correlation of pharmacology with related medical sciences	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1150	Course Title: HERBAL DRUG TECHNOLOGY (Practical)	Credits= 2		
	Semester : VI	**Total Contact Hours: 60**	**L**	**T**	**P**
			-	-	4

List of Prerequisite Courses

Herbal Drug Technology (Theory)

List of Courses where this course will be Prerequisite

Quality Control and Standardization of Herbals

Description of relevance of this course in the B. Pharm Programme

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

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

1. Perform phytochemical screening of crude drugs
2. Perform various tests for evaluation of herbal drugs
3. Prepare the herbal cosmetics, natural sweeteners, nutraceuticals

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	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	
	List of Text Book/ Reference Books	
	1. Textbook of Pharmacognosy by Trease &Evans. 2. Textbook of Pharmacognosy byTyler, 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.	
	Course Outcomes (Students will be able to…..)	
CO1	Perform phytochemical screening of crude drugs	
CO2	Perform various tests for evaluation of herbal drugs	
CO3	Prepare the herbal cosmetics, natural sweeteners, nutraceuticals	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K5	3	2	2	3	2	2	2	2	2	2	2
CO3	K5	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester VII

	Course Code: PHT1153	Course Title: INSTRUMENTAL METHODS OF ANALYSIS (THEORY)	Credits= 4		
	Semester: VII	**Total Contact Hours: 60 hours**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutical Analysis- I

List of Courses where this course will be Prerequisite

Instrumental Methods of Analysis (Practical)

Description of relevance of this course in the B. Pharm Programme

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

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT –I** **UV Visible spectroscopy** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. Applications - Spectrophotometric titrations, Single component and multi component analysis **Fluorimetry** Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications	10 Hours

2	**UNIT –II** **IR spectroscopy** Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications **Flame Photometry-**Principle, interferences, instrumentation and applications **Atomic absorption spectroscopy**- Principle, interferences, instrumentation and applications **Nepheloturbidometry**- Principle, instrumentation and applications	10 Hours
3	**UNIT –III** **Introduction to chromatography** **Adsorption and partition column chromatography-**Methodology, advantages, disadvantages and applications. **Thin layer chromatography-** Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. **Paper chromatography-**Introduction, methodology, development techniques, advantages, disadvantages and applications **Electrophoresis**– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications	10 hours
4	**UNIT –IV** **Gas chromatography -** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications **High performance liquid chromatography (HPLC)-** Introduction, theory, instrumentation, advantages and applications.	08 Hours
5	**UNIT –V** **Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications **Gel chromatography-** Introduction, theory, instrumentation and applications	07 Hours

	Affinity chromatography- Introduction, theory, instrumentation and applications	
	List of Text Book/ Reference Books	
	s by B.K Sharma 2. Organic spectroscopy by Y.R Sharma 3. Text book of Pharmaceutical Analysis by Kenneth A. Connors 4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel 5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake 6. Organic Chemistry by I. L. Finar 7. Organic spectroscopy by William Kemp 8. Quantitative Analysis of Drugs by D. C. Garrett 9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi 10. Spectrophotometric identification of Organic Compounds by Silverstein	
	Course Outcomes (Students will be able to…..)	
CO1	Describe the fundamental phenomenon underlying each of spectroscopic techniques and their instrumentation	
CO2	Define and explain glossary with examples in each techniques	
CO3	Solve the problems based on spectroscopic techniques	
C04	Able to corelate the knowledge of spectroscopic techniques with Pharmacopoeial monographs	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K4	3	3	3	2	3	3	3	2	3	3	3
CO4	K3	3	3	3	2	3	3	3	3	3	3	3
Course	K4	3	3	3	2	3	3	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1154	Course Title: INDUSTRIAL PHARMACY II (Theory)	Credits= 4		
	Semester: VII	Total Contact Hours: 60 hours	L	T	P
			3	1	-

List of Prerequisite Courses

Industrial Pharmacy I (Theory)

List of Courses where this course will be Prerequisite

Novel Drug Delivery Systems

Description of relevance of this course in the B. Pharm Programme

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

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Pilot plant scale up techniques:** General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology	10 hours
2	**UNIT-II** **Technology development and transfer:** WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues	10 hours

3	**UNIT-III** **Regulatory affairs:** Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals **Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.	10 Hours
4	**UNIT-IV** **Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP	08 Hours
5	**UNIT-V** **Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.	07 Hours
	List of Text Book/ Reference Books	
	1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http, //en.wikipedia.org/wiki/Regulatory_ Affairs. 2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php 3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition. 4. Regulatory Affairs brought bylearning plus, inc. available at http.//www.cgmp.com/ra.htm.	
	Course Outcomes (Students will be able to…..)	
CO1	Know the process of pilot plant and scale up of pharmaceutical dosage forms	
CO2	Understand the process of technology transfer from lab scale to commercial batch	
CO3	Know different Laws and Acts that regulate pharmaceutical industry	
C04	Understand the approval process and regulatory requirements for drug products	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	3	2	1	2	2	2	2	2	2	2
CO2	K2	3	3	2	1	2	2	2	2	2	2	2
CO3	K2	3	3	2	1	2	2	2	2	2	2	2
CO4	K2	3	3	2	1	2	2	2	2	2	2	2
Course	**K2**	3	3	2	1	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1155	Course Title: PHARMACY PRACTICE (Theory)	Credits= 4		
	Semester: VII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

Social and Preventive Pharmacy, Pharmacovigilance

Description of relevance of this course in the B. Pharm Programme

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

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

1. know various drug distribution methods in a hospital
2. appreciate the pharmacy stores management and inventory control
3. monitor drug therapy of patient through medication chart review and clinical review
4. obtain medication history interview and counsel the patients
5. identify drug related problems
6. detect and assess adverse drug reactions
7. interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. know pharmaceutical care services
9. do patient counseling in community pharmacy;
10. appreciate the concept of Rational drug therapy.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I:** **Hospital and it's organization** Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and medical staffs involved in the hospital and their functions. **Hospital pharmacy and its organization** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **Adverse drug reaction**	10 Hours

	Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. **Community Pharmacy** Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.	
2	**Unit II:** **Drug distribution system in a hospital** Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. **Hospital formulary** Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. **Therapeutic drug monitoring** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **Medication adherence** Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence. **Patient medication history interview** Need for the patient medication history interview, medication interview forms. **Community pharmacy management** Financial, materials, staff, and infrastructure requirements.	10 Hours
3	**Unit III:** **Pharmacy and therapeutic committee** Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. **Drug information services** Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. **Patient counselling** Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist **Education and training program in the hospital**	10 hours

	Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. **Prescribed medication order and communication skills** Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.	
4	Unit IV: **Budget** preparation and implementation Budget preparation and implementation **Clinical Pharmacy** Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. **Over the counter (OTC) sales** Introduction and sale of over the counter, and Rational use of common over the counter medications.	8 Hours
5	**Unit V** **Drug store management and inventory control** Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure **Investigational use of drugs** Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. **Interpretation of Clinical Laboratory Tests** Blood chemistry, hematology, and urinalysis	7 Hours
	List of Text Book/ Reference Books	
	1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001. 2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills,* 1st ed. Chennai: Orient Longman Private Limited; 2004. 3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986. 4. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008. 5. Scott LT. *Basic skills in interpreting laboratory data*, 4thed.	

	American Society of Health System Pharmacists Inc; 2009. 6. Parmar N.S. *Health Education and Community Pharmacy,* 18th ed. India: CBS Publishers & Distributers; 2008.	
	List of Journals	
	1. Therapeutic drug monitoring. ISSN: 0163-4356 2. Journal of pharmacy practice. ISSN : 0974-8326 3. American journal of health system pharmacy. ISSN: 1535-2900 (online) 4. Pharmacy times (Monthly magazine)	
	Course Outcomes (Students will be able to…..)	
CO1	Appreciate the pharmacy stores management and inventory control	
CO2	Detect and assess adverse drug reactions	
CO3	Do patient counselling in community pharmacy;	
C04	Appreciate the concept of Rational drug therapy.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	3	3	2	2	2	2	2	2	2	2
CO2	K3	3	3	3	3	2	2	2	2	2	2	2
CO3	K3	3	3	3	3	2	2	2	2	2	2	2
CO4	K2	3	3	3	3	2	2	2	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1156	Course Title: NOVEL DRUG DELIVERY SYSTEMS (Theory)	Credits= 4		
	Semester: VII	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutics I, Physical Pharmacy, Pharmaceutical Engineering, Industrial Pharmacy I

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Objectives: Upon completion of the course student shall be able

1. To understand various approaches for development of novel drug delivery systems.
2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit-I** **Controlled drug delivery systems**: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design-controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.	10 Hours
2	**Unit-II** **Microencapsulation:** Definition, advantages and disadvantages, microspheres /Microcapsules, microparticles, methods of microencapsulation, applications **Mucosal Drug Delivery system:** Introduction, Principles of bio adhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems **Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump	10 Hours
4	**Unit-III** **Transdermal Drug Delivery Systems:** Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches	10 Hours

	Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers	
5	**Unit-IV** **Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, neosomes, nanoparticles, monoclonal antibodies and their applications	08 Hours
6	**Unit-V** **Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications	07 Hours
	List of Text Book/ Reference Books	
	1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992. 2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992. 3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim 4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001). 5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.	
	List of Journals	
	1. Indian Journal of Pharmaceutical Sciences (IPA) 2. Indian Drugs (IDMA) 3. Journal of Controlled Release (Elsevier Sciences) 4. Drug Development and Industrial Pharmacy (Marcel & Decker) 5. International Journal of Pharmaceutics (Elsevier Sciences)	
	Course Outcomes (Students will be able to…..)	
CO1	To understand various approaches for development of novel drug delivery systems.	
CO2	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHP1151	Course Title: INSTRUMENTAL METHODS OF ANALYSIS (Practical)	Credits= 2		
	Semester: VII	Total Contact Hours: 30	L	T	P
			-	-	4

List of Prerequisite Courses

Instrumental methods of Analysis (Theory)

List of Courses where this course will be Prerequisite

Advanced Instrumentation Techniques

Description of relevance of this course in the B. Pharm Programme

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

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
	1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds	
	2 Estimation of dextrose by colorimetry	
	3 Estimation of sulfanilamide by colorimetry	
	4 Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy	
	5 Assay of paracetamol by UV- Spectrophotometry	
	6 Estimation of quinine sulfate by fluorimetry	
	7 Study of quenching of fluorescence	
	8 Determination of sodium by flame photometry	

	9 Determination of potassium by flame photometry 10 Determination of chlorides and sulphates by nephelo turbidometry 11 Separation of amino acids by paper chromatography 12 Separation of sugars by thin layer chromatography 13 Separation of plant pigments by column chromatography 14 Demonstration experiment on HPLC 15 Demonstration experiment on Gas Chromatography	
	List of Text Book/ Reference Books	
	1. Instrumental Methods of Chemical Analysis by B.K Sharma 2. Organic spectroscopy by Y.R Sharma 3. Text book of Pharmaceutical Analysis by Kenneth A. Connors 4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel 5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake 6. Organic Chemistry by I. L. Finar 7. Organic spectroscopy by William Kemp 8. Quantitative Analysis of Drugs by D. C. Garrett 9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi 10. Spectrophotometric identification of Organic Compounds by Silverstein	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis	
CO2	Understand the chromatographic separation and analysis of drugs.	
CO3	Perform quantitative & qualitative analysis of drugs using various analytical instruments.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K3	3	2	2	3	2	2	2	2	2	2	2
CO2	K3	3	2	2	3	2	2	2	2	2	2	2
CO3	K3	3	2	2	3	2	2	2	2	2	2	2
Course	**K3**	3	2	2	3	2	2	2	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

Semester VIII

	Course Code: PHT1157	Course Title: BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)	Credits= 4		
	Semester: VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

Project work

Description of relevance of this course in the B. Pharm Programme

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

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

- Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
- Know the various statistical techniques to solve statistical problems
- Appreciate statistical techniques in solving the problems**.**

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit-I** **Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency**: Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion**: Dispersion, Range, standard deviation, Pharmaceutical problems **Correlation**: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples	10 Hours
2	**Unit-II** **Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression– Pharmaceutical Examples **Probability:**Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems Sample, Population, large sample, small sample, Null hypothesis,	10 Hours

	alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples **Parametric test**: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference	
3	**Unit-III** **Non-Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test **Introduction to Research:** Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.	10 Hours
4	**Unit-IV** Blocking and confounding system for Two-level factorials **Regression modeling:** Hypothesis testing in Simple and Multiple regressionmodels **Introduction to Practical components of Industrial and Clinical Trials Problems**: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach	8 Hours
5	Unit-V **Design and Analysis of experiments:** **Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design **Response Surface methodology**: Central composite design, Historical design, Optimization Techniques	7 Hours
	List of Text Book/ Reference Books	
	1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork. 2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha 3. Design and Analysis of Experiments –PHI Learning Private Limited,R. Pannerselvam, 4. Design and Analysis of Experiments –Wiley Students Edition,	

	Douglas and C. Montgomery	
	Course Outcomes (Students will be able to…..)	
CO1	Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)	
CO2	Know the various statistical techniques to solve statistical problems	
CO3	Appreciate statistical techniques in solving the problems.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	3	3	2	3	3	3	3	3
Course	**K3**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1158	Course Title: SOCIAL AND PREVENTIVE PHARMACY	Credits= 4		
	Semester : VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmacy Practice

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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

Objectives: After the successful completion of this course, the student shall be able to:
•Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
•Have a critical way of thinking based on current healthcare development.
•Evaluate alternative ways of solving problems related to health and pharmaceutical issues

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I:** **Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. **Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health **Hygiene and health:** personal hygiene and health care; avoidable habits	10 Hours
2	Unit II: **Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse	10 Hours
3	Unit III: National health programs, its objectives, functioning and outcome of the	10 Hours

	following: HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	
4	Unit IV: National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program	08 Hours
5	Unit V: Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	07 Hours
	List of Text Book/ Reference Books	
	1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications 2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications 3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications 4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications 5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS. 6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad 7. Research in Social and Administrative Pharmacy, Elsevier, Ireland	
	Course Outcomes (Students will be able to…..)	
CO1	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.	
CO2	Have a critical way of thinking based on current healthcare development.	
CO3	Evaluate alternative ways of solving problems related to health and pharmaceutical issues	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	2	2	2	1	2	2	3	2	3	3	3
CO2	K2	2	2	2	1	2	2	3	2	3	3	3
CO3	K2	2	2	2	1	2	2	3	2	3	3	3
Course	**K3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1159	Course Title: PHARMA MARKETING MANAGEMENT (Theory)	Credits= 4		
	Semester: VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

Scope:

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

Course Objective: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research.	10 Hours
2	**Unit II** **Product decision:** Classification, product line and product mix decisions, product life cycle,product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.	10 Hours

3	**Unit III** **Promotion:** Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.	10 Hours
4	**Unit IV** **Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.	10 Hours
5	**Unit V** **Pricing:** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order)and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing.	10 Hours
	List of Text Book/ Reference Books	
	1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi 2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi. 3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill 4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India 5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition) 6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, IndianContext,Macmilan India, New Delhi.	

	7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi 8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand marketing concepts and techniques and their applications in the pharmaceutical industry	
CO2	Role of Professional Sales Representative	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	2	2	2	2	2	2	2
CO2	K2	3	2	2	1	2	2	2	2	2	2	2
Course	**K2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1160	Course Title: PHARMACEUTICAL REGULATORY SCIENCE (Theory)	Credits= 4		
	Semester: VIII	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Pharmaceutical Jurisprudence

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I:** **New Drug Discovery and development** Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.	10 Hours
2	**Unit II** **Regulatory Approval Process** Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA. **Regulatory authorities and agencies** Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	10 Hours

3	**Unit III** **Registration of Indian drug product in overseas market** Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research.	10 Hours
4	**Unit IV** **Clinical trials** Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials	08 Hours
5	**Unit V** **Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	07 Hours
	List of Text Book/ Reference Books	
	1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan. 2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Health care Publishers. 3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190. 4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc. 5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus. 6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143	

	7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams 8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene 9. Drugs: From Discovery to Approval, Second Edition By Rick Ng	
	Course Outcomes (Students will be able to…..)	
CO1	Know about the process of drug discovery and development	
CO2	Know the regulatory approval process and their registration in Indian and international markets	
CO3	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1161	Course Title: PHARMACOVIGILANCE (Theory)	Credits= 4		
	Semester: VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmacy Practice

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

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

Objectives: At completion of this paper it is expected that students will be able to (know, do, and appreciate):

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs
7. Adverse drug reaction reporting systems and communication in pharmacovigilance
8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
9. Drug safety evaluation in pediatrics, geriatrics, pregnancy and lactation
10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
12. CIOMS requirements for ADR reporting
13. Writing case narratives of adverse events and their quality.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Introduction to Pharmacovigilance** • History and development of Pharmacovigilance • Importance of safety monitoring of Medicine • WHO international drug monitoring programme • Pharmacovigilance Program of India(PvPI) **Introduction to adverse drug reactions** • Definitions and classification of ADRs • Detection and reporting • Methods in Causality assessment	10 Hours

	• Severity and seriousness assessment • Predictability and preventability assessment • Management of adverse drug reactions **Basic terminologies used in pharmacovigilance** • Terminologies of adverse medication related events • Regulatory terminologies	
2	**Unit II** **Drug and disease classification** • Anatomical, therapeutic and chemical classification of drugs • International classification of diseases • Daily defined doses • International Non proprietary Names for drugs **Drug dictionaries and coding in pharmacovigilance** • WHO adverse reaction terminologies • MedDRA and Standardised MedDRA queries • WHO drug dictionary • Eudravigilance medicinal product dictionary **Information resources in pharmacovigilance** • Basic drug information resources • Specialised resources for ADRs **Establishing pharmacovigilance programme** o Establishing in a hospital o Establishment & operation of drug safety department in industry o Contract Research Organisations (CROs) o Establishing a national programme	10 hours
3	**Unit III** **Vaccine safety surveillance** • Vaccine Pharmacovigilance • Vaccination failure • Adverse events following immunization **Pharmacovigilance methods** • Passive surveillance – Spontaneous reports and case series • Stimulated reporting • Active surveillance – Sentinel sites, drug event monitoring and registries • Comparative observational studies – Cross sectional study, case control study and cohort study • Targeted clinical investigations	10 Hours

	Communication in pharmacovigilance • Effective communication in Pharmacovigilance • Communication in Drug Safety Crisis management • Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	
4	**Unit IV** **Safety data generation** • Pre clinical phase • Clinical phase • Post approval phase (PMS) **ICH Guidelines for Pharmacovigilance** • Organization and objectives of ICH • Expedited reporting • Individual case safety reports • Periodic safety update reports • Post approval expedited reporting • Pharmacovigilance planning • Good clinical practice in pharmacovigilance studies	08 Hours
5	**Unit V** **Pharmacogenomics of adverse drug reactions** • Genetics related ADR with example focusing PK parameters. **Drug safety evaluation in special population** • Paediatrics • Pregnancy and lactation • Geriatrics **CIOMS** • CIOMS Working Groups • CIOMS Form **CDSCO (India) and Pharmacovigilance** • D&C Act and Schedule Y • Differences in Indian and global pharmacovigilance requirements	07 hours
	List of Text Book/ Reference Books	
	1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers. 2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers. 3. Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers.	

	4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers. 5. An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers. 6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers. 7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers. 8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G. Parthasarathi, Karin NyfortHansen,Milap C. Nahata 9. National Formulary of India 10. Text Book of Medicine by Yashpal Munjal 12. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Mannahttp://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn 3=7297 13. http://www.ich.org/ 14. http://www.cioms.ch/ 15. http://cdsco.nic.in/ 16. http://www.who.int/vaccine_safety/en/ 17. http://www.ipc.gov.in/PvPI/pv_home.html	
	Course Outcomes (Students will be able to…..)	
CO 1	History and development of pharmacovigilance	
CO 2	National and international scenario of pharmacovigilance	
CO 3	Dictionaries, coding and terminologies used in pharmacovigilance	
CO 4	Detection of new adverse drug reactions and their assessment	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	2	2	2	2
CO2	K2	3	2	2	1	3	2	3	2	2	2	2
CO3	K2	3	2	2	1	3	2	3	2	2	2	2
CO4	K2	3	2	2	1	3	2	3	2	2	2	2
Course	K2	3	2	2	1	3	2	3	2	2	2	2

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1162	**Course Title:** QUALITY CONTROL AND STANDARDIZATION OF HERBALS (Theory)	**Credits= 4**		
	Semester: VIII	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Herbal Drug Technology

List of Courses where this course will be Prerequisite

Project work

Description of relevance of this course in the B. Pharm Programme

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

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

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use	10 hours
2	**Unit II** **Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	10 hours
3	**Unit III** EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	10 hours

4	**Unit IV** Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.	08 hours
5	**Unit V** Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products	07 hours
	List of Text Book/ Reference Books	
	1. Pharmacognosy by Trease and Evans 2. Pharmacognosy by Kokate, Purohit and Gokhale 3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006. 4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002. 5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products, 6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002. 7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8. 8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998. 9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981. 10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999. 11. WHO. WHO Global Atlas of Traditional, Complementary and	

	Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005. 12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.	
	Course Outcomes (Students will be able to…..)	
CO1	Know WHO guidelines for quality control of herbal drugs	
CO2	Know Quality assurance in herbal drug industry	
CO3	Know the regulatory approval process and their registration in Indian and international markets	
C04	Appreciate EU and ICH guidelines for quality control of herbal drugs	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	2	2	2	2
CO2	K2	3	2	2	1	3	2	3	2	2	2	2
CO3	K2	3	2	2	1	3	2	3	2	2	2	2
CO4	K2	3	2	2	1	3	2	3	2	2	2	2
Course	**K2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1163	Course Title: COMPUTER AIDED DRUG DESIGN (Theory)	Credits= 4		
	Semester : VIII	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Medicinal Chemistry

List of Courses where this course will be Prerequisite

Project work

Description of relevance of this course in the B. Pharm Programme

Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

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

- Design and discovery of lead molecules
- The role of drug design in drug discovery process
- The concept of QSAR and docking
- Various strategies to develop new drug like molecules.
- The design of new drug molecules using molecular modeling software

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Introduction to Drug Discovery and Development** Stages of drug discovery and development **Lead discovery and Analog Based Drug Design** Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. **Analog Based Drug Design:** Bioisosterism, Classification, Bioisosteric replacement. Any three case studies	10 Hours
2	**UNIT-II** **Quantitative Structure Activity Relationship (QSAR)** SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR	10 Hours

	approaches like COMFA and COMSIA.	
3	**UNIT-III** **Molecular Modeling and virtual screening techniques** **Virtual Screening techniques:** Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, **Molecular docking**: Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design	10 Hours
4	**UNIT-IV** **Informatics & Methods in drug design** Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	08 Hours
5	**UNIT-V** **Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination	07 Hours
	List of Text Book/ Reference Books	
	1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore. 2. Martin YC. "Quantitative Drug Design" Dekker, New York. 3. Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York. 4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger. 5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience. 6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York. 7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press. 8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston. 9. Silverman R.B. "The organic Chemistry of Drug Design and Drug	

	Action" Academic Press New York.	
	Course Outcomes (Students will be able to…..)	
CO1	Design and discovery of lead molecules	
CO2	The concept of QSAR and docking	
CO3	Various strategies to develop new drug like molecules.	
C04	The design of new drug molecules using molecular modeling software	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1164	**Course Title:** CELL AND MOLECULAR BIOLOGY	**Credits= 4**		
	Semester : VIII	**Total Contact Hours: 60**	**L**	**T**	**P**
			3	1	-

List of Prerequisite Courses

Biochemistry

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

Scope:

- Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

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

- Summarize cell and molecular biology history.
- Summarize cellular functioning and composition.
- Describe the chemical foundations of cell biology.
- Summarize the DNA properties of cell biology.
- Describe protein structure and function.
- Describe cellular membrane structure and function.
- Describe basic molecular genetic mechanisms.
- Summarize the Cell Cycle

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Cell and Molecular Biology: Definitions theory and basics and Applications.** a) Cell and Molecular Biology: History and Summation. b) Properties of cells and cell membrane. c) Prokaryotic versus Eukaryotic d) Cellular Reproduction e) Chemical Foundations – an Introduction and Reactions (Types)	10 Hours
2	**Unit II** **DNA and the Flow of Molecular Information** a) DNA Functioning b) DNA and RNA	10 Hours

	c) Types of RNA d) Transcription and Translation	
3	**Unit III** a) Proteins: Defined **and** Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	10 Hours
4	**Unit IV** **Science of Genetics** a) Transgenics and Genomic Analysis b) Cell Cycle analysis c) Mitosis and Meiosis d) Cellular Activities and Checkpoints	08 Hours
5	**Unit V** **Cell Signals: Introduction** a) Receptors for Cell Signals b) Signaling Pathways: Overview c) Misregulation of Signaling Pathways d) Protein-Kinases: Functioning	07 Hours
	List of Text Book/ Reference Books	
	1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London. 2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi. 3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn. 4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology. 5. Rose: Industrial Microbiology. 6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan 7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution. 8. Peppler: Microbial Technology. 9. Edward: Fundamentals of Microbiology. 10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi 11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company	

	12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C. 13. RA Goldshy et. al., Kuby Immunology.	
	Course Outcomes (Students will be able to…..)	
CO1	Summarize the DNA properties of cell biology, protein structure and their functions	
CO2	Summarize cellular functioning and composition	
CO3	Describe cellular membrane structure and function	
C04	Describe basic molecular genetic mechanisms.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1165	Course Title: COSMETIC SCIENCE (Theory)	Credits= 4		
	Semester : VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmaceutics I, Novel Drug Delivery Systems

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT I** Classification of cosmetic and cosmeceutical products Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application **Skin:** Basic structure and function of skin. **Hair:** Basic structure of hair. Hair growth cycle. **Oral Cavity:** Common problem associated with teeth and gums.	10 Hours
2	UNIT II **Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.Application of these products in formulation of cosmecuticals. **Antiperspants & deodorants**- Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner,anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.	10 Hours
3	**UNIT III** Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** Skin Care: Aloe	10 Hours

	and turmeric Hair care: Henna and amla. Oral care: Neem and clove **Analytical cosmetics:** BIS specification and analytical methods for shampoo, skin- cream and toothpaste**.**	
4	**UNIT IV** Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps,and syndet bars. Evolution and skin benfits.	08 Hours.
5	**UNIT V** Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action	07 Hours
	List of Text Book/ Reference Books	
	1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin. 2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi. 3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand classification of cosmetics and cosmetic excipients	
CO2	Understand the formulation and evaluation of different cosmetic products	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1166	Course Title: EXPERIMENTAL PHARMACOLOGY	Credits=4		
	Semester : VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Pharmacology III

List of Courses where this course will be Prerequisite

Project work

Description of relevance of this course in the B. Pharm Programme

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

Objectives:

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

- Appreciate the applications of various commonly used laboratory animals.
- Appreciate and demonstrate the various screening methods used in preclinical research
- Appreciate and demonstrate the importance of biostatistics and research methodology
- Design and execute a research hypothesis independently

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit I** **Laboratory Animals:** Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	10 hours
2	**Unit II** **Preclinical screening models** a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. **b. Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's,antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease	10 hours
3	**Unit III** **Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics	10 hours

4	**Unit IV** **Preclinical screening models:** for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	10 hours
5	**Research methodology and Bio-statistics** Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	05 hours
	List of Text Book/ Reference Books	
	1. Fundamentals of experimental Pharmacology-by M.N.Ghosh 2. Hand book of Experimental Pharmacology-S.K.Kulakarni 3. CPCSEA guidelines for laboratory animal facility. 4. Drug discovery and Evaluation by VogelH.G. 5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta 6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard	
	Course Outcomes (Students will be able to…..)	
CO1	Appreciate the applications of various commonly used laboratory animals.	
CO2	Appreciate and demonstrate the various screening methods used in preclinical research	
CO3	Appreciate and demonstrate the importance of biostatistics and research methodology	
C04	Design and execute a research hypothesis independently	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1167	Course Title: ADVANCED INSTRUMENTATION TECHNIQUES	Credits= 4		
	Semester : VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Instrumental Methods of Analysis

List of Courses where this course will be Prerequisite

Project work

Description of relevance of this course in the B. Pharm Programme

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

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

- understand the advanced instruments used and its applications in drug analysis
- understand the chromatographic separation and analysis of drugs.
- understand the calibration of various analytical instruments
- know analysis of drugs using various analytical instruments.

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT-I** **Nuclear Magnetic Resonance spectroscopy** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications **Mass Spectrometry**- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	10 Hours
2	**UNIT-II** **Thermal Methods of Analysis**: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) **X- Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, X- ray Crystallography, rotating crystal technique, single crystal	10 Hours

	diffraction, powder diffraction, structural elucidation and applications.	
3	**UNIT-III** **Calibration and validation-**as per ICH and USFDA guidelines **Calibration of following Instruments** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC	10 Hours
4	**UNIT-IV** **Radio immune assay:**Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay **Extraction techniques**:General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	08 Hours
5	**UNIT-V** **Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS.	07 Hours
	List of Text Book/ Reference Books	
	1. Instrumental Methods of Chemical Analysis by B.K Sharma 2. Organic spectroscopy by Y.R Sharma 3. Text book of Pharmaceutical Analysis by Kenneth A. Connors 4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel 5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake 6. Organic Chemistry by I. L. Finar 7. Organic spectroscopy by William Kemp 8. Quantitative Analysis of Drugs by D. C. Garrett 9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi 10. Spectrophotometric identification of Organic Compounds by Silverstein	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the advanced instruments used and its applications in drug analysis	
CO2	Understand the chromatographic separation and analysis of drugs	
CO3	Understand the calibration of various analytical instruments	

C04	Know analysis of drugs using various analytical instruments.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	3	3	3	3
CO2	K2	3	2	2	1	3	2	3	3	3	3	3
CO3	K2	3	2	2	1	3	2	3	3	3	3	3
CO4	K2	3	2	2	1	3	2	3	3	3	3	3
Course	**K2**	3	2	2	1	3	2	3	3	3	3	3

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1168	Course Title: DIETARY SUPPLEMENTS AND NUTRACEUTICALS	Credits= 4		
	Semester : VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Herbal Drug technology

List of Courses where this course will be Prerequisite

Not applicable

Description of relevance of this course in the B. Pharm Programme

Scope:

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

Objective:

This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to :

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

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**UNIT I** a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community. c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds	07 hours
2	UNIT II Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following a. Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin b. Sulfides: Diallyl sulfides, Allyl trisulfide. c. Polyphenolics: Reservetrol	15 hours

	d. Flavonoids- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones e. Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum f. Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans g. Tocopherols h. Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.	
3	**UNIT III** a. Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids. b. Dietary fibres and complex carbohydrates as functional food ingredients..	07 hours
4	UNIT IV a. Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing b. Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c. Functional foods for chronic disease prevention	10 hours
5	UNIT V a. Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. b. Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. c. Pharmacopoeial Specifications for dietary supplements and nutraceuticals	06 hours
	List of Text Book/ Reference Books	
	1. Dietetics by Sri Lakshmi 2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPunblication. 3. Advanced Nutritional Therapies by Cooper. K.A., (1996). 4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988). 5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997). 6. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead	

	Publ.Co.London. 7. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York. 8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in *Essentials of Functional Foods* M.K. Sachmidl and T.P. Labuza eds. Aspen Press. 9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition) 10. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger	
	Course Outcomes (Students will be able to…..)	
CO1	Understand the need of supplements by the different group of people to maintain healthy life.	
CO2	Understand the outcome of deficiencies in dietary supplements.	
CO3	Appreciate the components in dietary supplements and the application	
C04	Appreciate the regulatory and commercial aspects of dietary supplements including health claims.	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)

		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
		K3	K4	K4	K6	K3, P	K4	K3, A	K2, A	K3,A	K3, P	K2, A+P
CO1	K2	3	2	2	1	3	2	3	2	2	2	2
CO2	K2	3	2	2	1	3	2	3	2	2	2	2
CO3	K2	3	2	2	1	3	2	3	2	2	2	2
CO4	K2	3	2	2	1	3	2	3	2	2	2	2
Course	**K3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution
K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain

	Course Code: PHT1169	Course Title: PHARMACEUTICAL PRODUCT DEVELOPMENT	Credits= 4		
	Semester: VIII	Total Contact Hours: 60	L	T	P
			3	1	-

List of Prerequisite Courses

Not applicable

List of Courses where this course will be Prerequisite

Project work

Sr. No.	Course Contents (Topics and Subtopics)	Required Hours
1	**Unit-I** Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms	10 Hours
2	**Unit-II** An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non - ionic surfactants and their applications iv. Polyethylene glycols and sorbitols v. Suspending and emulsifying agents vi. Semi solid excipients	10 Hours
3	**Unit-III** An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications	10 Hours
4	**Unit-IV** Optimization techniques in pharmaceutical product development.A study of various optimization techniques for pharmaceutical product development with specific examples.Optimization by factorial designs and their applications.A study of QbD and its application in pharmaceutical product development.	08 Hours

5	**Unit-V** Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	07 Hours
	List of Text Book/ Reference Books	
	1. Pharmaceutical Statistics Practical and Clinical Applications by Stanford Bolton, CharlesBon; Marcel Dekker Inc. 2. Encyclopedia of Pharmaceutical Technology, edited by James swarbrick, Third Edition, Informa Healthcare publishers. 3. Pharmaceutical Dosage Forms, Tablets, Volume II, edited by Herbert A. Lieberman and Leon Lachman; Marcel Dekker, Inc. 4. The Theory and Practice of Industrial Pharmacy, Fourth Edition, edited by Roop kKhar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS Publishers and Distributors Pvt.Ltd. 2013. 5. Martin's Physical Pharmacy and Pharmaceutical Sciences, Fifth Edition, edited by Patrick J. Sinko, BI Publications Pvt. Ltd. 6. Targeted and Controlled Drug Delivery, Novel Carrier Systems by S. P. Vyas and R. K.Khar, CBS Publishers and Distributors Pvt. Ltd, First Edition 2012. 7. Pharmaceutical Dosage Forms and Drug Delivery Systems, Loyd V. Allen Jr., Nicholas B.Popovich, Howard C. Ansel, 9th Ed. 40 8. Aulton's Pharmaceutics – The Design and Manufacture of Medicines, Michael E. Aulton, 3rd Ed. 9. Remington – The Science and Practice of Pharmacy, 20th Ed. 10. Pharmaceutical Dosage Forms – Tablets Vol 1 to 3, A. Liberman, Leon Lachman and Joseph B. Schwartz 11. Pharmaceutical Dosage Forms – Disperse Systems Vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker. 12. Pharmaceutical Dosage Forms – Parenteral Medication Vol 1 & 2, Kenneth E. Avis and H.A. Libermann. 13. Advanced Review Articles related to the topics.	
	Course Outcomes (Students will be able to…..)	
CO1	Understand pharmaceutical product development	

CO2	Understand pharmaceutical excipients	
CO3	Understand and appreciate Optimization techniques	
C04	Understand quality control of packaging materials	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs)												
		PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
		K3	**K4**	**K4**	**K6**	**K3, P**	**K4**	**K3, A**	**K2, A**	**K3,A**	**K3, P**	**K2, A+P**
CO1	K2	3	2	2	1	3	2	3	2	2	2	2
CO2	K2	3	2	2	1	3	2	3	2	2	2	2
CO3	K2	3	2	2	1	3	2	3	2	2	2	2
CO4	K2	3	2	2	1	3	2	3	2	2	2	2
Course	**K2**	**3**	**2**	**2**	**1**	**3**	**2**	**3**	**2**	**2**	**2**	**2**

3, Strong Contribution; 2, Moderate Contribution; 1, Low Contribution; 0, No Contribution

K, Knowledge-level from cognitive domain; A, Affective domain; P, Psychomotor domain