

AMITY INSTITUTE OF PHARMACY

**BACHELOR OF PHARMACY
2018-19**

PROGRAMME HANDBOOK



AMITY UNIVERSITY HARYANA
Amity Education Valley, Panchgaon, Gurugram, Haryana

Amity Institute of Pharmacy

Programme Overview: B. Pharm

Duration: 4 years

B Pharmacy programme has a duration of 8 semesters and the objective of the curriculum is to impart quality education with skilled practical efficiency pertaining to the Pharmaceutical Sciences to provide standard ethical pharmaceutical services to hospital and community pharmacies, drug manufacturing industries, marketing, national/regional health bureaus, teaching and research institutes, drug administration, quality control/quality assurance & as per aspirations of the pharmaceutical industries. The curriculum also includes an industrial training program in a pharmaceutical company.

Programme Outcomes (POs)

PO1. Pharmacy knowledge: Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences behavioural, social and administrative pharmacy sciences and manufacturing practices.

PO2. Planning Abilities: Demonstrate effective planning abilities including time management, resource management, delegation skills, and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO3. Problem analysis: Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find analyze, evaluate and apply information systematically and shall make defensible decisions.

PO4. Modern tool usage: Learn, select and apply appropriate methods and procedures, resources and modern pharmacy related computing tools with an understanding of the limitations.

PO5. Leadership skills: Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfilment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizen or leadership roles when appropriate to facilitate improvement in health and well-being.

PO6. Professional Identity: Understand, analyze and communicate the value of their professional roles in society (e.g. healthcare professionals, promoters of health, educators, managers, employers, employees.)

PO7. Pharmaceutical Ethics: Honour personal values and apply ethical principles in professional and social contexts. Demonstrate behavioural that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO8. Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO9. The Pharmacist and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO10. Environment and Sustainability: Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.

PO11. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self-assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

Programme Specific Outcomes (PSOs)

PSO1. Able to apply the knowledge gained during the course of the program from pharmacology, pharmaceuticals, medicinal chemistry, Pharmacognosy, APHE, communication skills, pharmaceutical analysis, Biotechnology, biochemistry, cosmetology and environmental studies.

PSO2. Able to apply the knowledge of ethical and management principles required to work in a team as well as to lead a team.

PSO3. Able to do multidisciplinary jobs in the pharmaceutical industries in various branches and would be able to write effective project reports in multidisciplinary environment in the context of changing technologies.

PSO4. Able to communicate easily and comfortably. Would be able to perform multitasks in multi fields including pharmaceutical & cosmetics. Research area would be strong.

Supporting document for PSOs of B. Pharm

[illegible]

[illegible]

13133 Bachelor of Pharmacy (Total Credits-234)

Programme Structure-2018

FIRST SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2101	Human Anatomy and Physiology-I	3	1	-	4
PHA2102	Pharmaceutical Analysis	3	1	-	4
PHA2103	Pharmaceutics	3	1	-	4
PHA2104	Pharmaceutical Inorganic Chemistry	3	1	-	4
PHA2105	Communication Skills	2	-	-	2
PHA2106	Human Anatomy and Physiology Practical-I	-	-	4	2
PHA2107	Pharmaceutical Analysis Practical	-	-	4	2
PHA2108	Pharmaceutics Practical	-	-	4	2
PHA2109	Pharmaceutical Inorganic Chemistry Practical	-	-	4	2
PHA2110	Communication Skills Practical	-	-	2	1
Electives (Any one/one group)					3
PHA2111	Remedial Mathematics	3	-	-	3
PHA2112	Remedial Biology	2	-	-	2
PHA2113	Remedial Biology Practical	-	-	2	1
Open Electives					1
BEH2151	Understanding Self for Effectiveness	1	-	-	1
TOTAL					31

SECOND SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2201	Human Anatomy and Physiology-II	3	1	-	4
PHA2202	Pharmaceutical Organic Chemistry-I	3	1	-	4
PHA2203	Biochemistry	3	1	-	4
PHA2204	Pathophysiology	3	1	-	4
PHA2205	Computer Applications in Pharmacy	3	-	-	3
PHA2206	Environmental Sciences	3	-	-	3
PHA2207	Human Anatomy and Physiology Practical-II	-	-	4	2
PHA2208	Pharmaceutical Organic Chemistry Practical-I	-	-	4	2

PHA2209	Biochemistry Practical	-	-	4	2
PHA2210	Computer Applications in Pharmacy Practical	-	-	2	1
	Open Electives				1
BEH2251	Problem Solving & Creative Thinking	1	-	-	1
	TOTAL				30

THIRD SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2301	Pharmaceutical Organic Chemistry-II	3	1	-	4
PHA2302	Physical Pharmaceutics-I	3	1	-	4
PHA2303	Pharmaceutical Microbiology	3	1	-	4
PHA2304	Pharmaceutical Engineering	3	1	-	4
PHA2305	Pharmaceutical Organic Chemistry Practical-II	-	-	4	2
PHA2306	Physical Pharmaceutics Practical-I	-	-	4	2
PHA2307	Pharmaceutical Microbiology Practical	-	-	4	2
PHA2308	Pharmaceutical Engineering Practical	-	-	4	2
	Open Electives				4
BEH2351	Group Dynamics & Team Building	1	-	-	1
LAN2151	Foreign Language-I	3	-	-	3
LAN2152	French-I				
LAN2153	German-I				
LAN2154	Spanish-I				
LAN2155	Russian-I				
LAN2156	Chinese-I				
LAN2157	Portuguese-I				
LAN2158	Korean-I				
LAN2159	Japanese-I Hindi-I **				
	TOTAL				28

** Hindi as Foreign Language for Foreign National Students

FOURTH SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2401	Pharmaceutical Organic Chemistry-III	3	1	-	4
PHA2402	Medicinal Chemistry-I	3	1	-	4
PHA2403	Physical Pharmaceutics-II	3	1	-	4
PHA2404	Pharmacology-I	3	1	-	4
PHA2405	Pharmacognosy and Phytochemistry-I	3	1	-	4
PHA2406	Medicinal Chemistry Practical-I	-	-	4	2
PHA2407	Physical Pharmaceutics Practical-II	-	-	4	2
PHA2408	Pharmacology Practical-I	-	-	4	2
PHA2409	Pharmacognosy and Phytochemistry Practical-I	-	-	4	2
Open Electives					5
CSS2451	Corporate Communication	1	-	-	1
BEH2451	Stress & Coping Strategies	1	-	-	1
LAN2251	Foreign Language-II	3			3
LAN2252	French-II				
LAN2253	German-II				
LAN2254	Spanish-II				
LAN2255	Russian-II				
LAN2256	Chinese-II				
LAN2257	Portuguese-II				
LAN2258	Korean-II				
LAN2259	Japanese-II				
	Hindi-II				
TOTAL					33

FIFTH SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2501	Medicinal Chemistry-II	3	1	-	4
PHA2502	Industrial Pharmacy-I	3	1	-	4
PHA2503	Pharmacology-II	3	1	-	4
PHA2504	Pharmacognosy and Phytochemistry-II	3	1	-	4
PHA2505	Pharmaceutical Jurisprudence	3	1	-	4
PHA2506	Industrial Pharmacy Practical-I	-	-	4	2
PHA2507	Pharmacology Practical-II	-	-	4	2
PHA2508	Pharmacognosy and Phytochemistry Practical-II	-	-	4	2
Open Electives					4
CSS2551	Employability Skills	1	-	-	1
BEH2551	Individual, Society & Nations	1	-	-	1
LAN2351	Foreign Language-III	2	-	-	2
LAN2352	French-III				
LAN2353	German-III				

LAN2354	Spanish -III				
LAN2355	Russian-III				
LAN2356	Chinese-III				
LAN2357	Portuguese-III				
LAN2358	Korean-III				
LAN2359	Japanese-III				
	Hindi-III				
	TOTAL				30

SIXTH SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2601	Medicinal Chemistry-III	3	1	-	4
PHA2602	Pharmacology-III	3	1	-	4
PHA2603	Herbal Drug Technology	3	1	-	4
PHA2604	Biopharmaceutics and Pharmacokinetics	3	1	-	4
PHA2605	Pharmaceutical Biotechnology	3	1	-	4
PHA2606	Quality Assurance	3	1	-	4
PHA2607	Medicinal Chemistry Practical-III	-	-	4	2
PHA2608	Pharmacology Practical-III	-	-	4	2
PHA2609	Herbal Drug Technology Practical	-	-	4	2
	Open Electives				4
CSS2651	Workplace Communication	1	-	-	1
BEH2651	Interpersonal Communication and Relationship Management	1	-	-	1
LAN2451	Foreign Language-IV	2	-	-	2
LAN2452	French-IV				
LAN2453	German-IV				
LAN2454	Spanish-IV				
LAN2455	Russian-IV				
LAN2456	Chinese-IV				
LAN2457	Portuguese-IV				
LAN2458	Korean-IV				
LAN2459	Japanese-IV				
	Hindi-IV				
	TOTAL				34

SEVENTH SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2701	Instrumental Methods of Analysis	3	1	-	4
PHA2702	Industrial Pharmacy-II	3	1	-	4
PHA2703	Pharmacy Practice	3	1	-	4
PHA2704	Novel Drug Delivery System	3	1	-	4
PHA2705	Instrumental Methods of Analysis Practical	-	-	4	2
PHA2706	Practice School	-	-	12	6
Open Electives					2
LAN2551	Foreign Language-V	2	-	-	2
LAN2552	French-V				
LAN2553	German-V				
LAN2554	Spanish-V				
LAN2555	Russian-V				
LAN2556	Chinese-V				
LAN2557	Portuguese-V				
LAN2558	Korean-V				
LAN2559	Japanese-V Hindi-V				
TOTAL					26

EIGHTH SEMESTER

Course Code	Course Title	Lecture(L) Hours Per Week	Tutorial (T) Hours Per week	Practical (P) Hours Per Week	Total Credits
PHA2801	Biostatistics and Research Methodology	3	1	-	4
PHA2802	Social and Preventive Pharmacy	3	1	-	4
PHA2837	Project Work	-	-	12	6
Electives (Any Two)					(4+4) 8
PHA2803	Pharma Marketing Management	3	1	-	4
PHA2804	Pharmaceutical Regulatory Science	3	1	-	4
PHA2805	Pharmacovigilance	3	1	-	4
PHA2806	Quality Control and Standardization of Herbals	3	1	-	4
PHA2807	Computer Aided Drug Design	3	1	-	4
PHA2808	Cell and Molecular Biology	3	1	-	4
PHA2809	Cosmetic Science	3	1	-	4
PHA2810	Experimental Pharmacology	3	1	-	4
PHA2811	Advanced Instrumentation Techniques	3	1	-	4
PHA2812	Dietary Supplements and Nutraceuticals	3	1	-	4
TOTAL					22

Syllabus – B. Pharm First Semester

PHA 2101	HUMAN ANATOMY AND PHYSIOLOGY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Explain the structure and functions of cardio, nervous, lymph, skin and skeletal muscles.

CO2. Describe the correlation of the body system with each other and their contributions towards homeostasis.

CO3. Identify the different type of tissue and bones, perform the quantitative analysis of blood cells.

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1, L2	10

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.		
Module 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.	L1, L2	10
Module III: Body fluids and blood: Body fluids, composition and functions of blood, hemopoiesis, 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.	L1, L2	10
Module 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.	L1, L2	08
Module V: Cardiovascular system: Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 Taylor. Williams & Wilkins Co, River-view, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 31
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2102	PHARMACEUTICAL ANALYSIS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject deals with the fundamentals of analytical chemistry and principles of electro-chemical analysis of drugs.

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Carry out the preparation and standardization of various molar and normal solutions.

CO2. Apply the theory of acid base indicators in order to carry out the titrations of strong, weak, and very weak acids and bases.

CO3. Explain the various methods for precipitation titrations, complexometric titration and gravimetry.

CO4. Perform various types of redox titrations including cerimetry, iodimetry, iodometry, bromatometry, and dichrometry.

CO5. Determine the normality by electro-analytical methods such as conductometry and potentiometry.

Course Content

Modules	Blooms level*	Number of hours
Module I: (a) Pharmaceutical analysis- Definition and scope i) Different techniques of analysis	L1, L2	10

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 thio-sulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate (b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures (c) Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.		
Module II: Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	L1, L2, L3	10
Module III: Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate. Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotisation titration.	L1, L2, L3	10
Module IV: Redox titrations (a) Concepts of oxidation and reduction (b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate	L1, L2, L3	08
Module V: Electrochemical methods of analysis Conductometry: Introduction, Conductivity cell, Conductometric titrations, applications.	L1, L2, L3	07

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

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2103	PHARMACEUTICS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Study the profession of Pharmacy- its history, scope and careers available, about pharmacopoeias and professional way of handling prescription.
2. Understanding the basics of different dosage forms, pharmaceutical incompatibilities and Pharmaceutical dose and relevant calculations.
3. Perform the preparation of various conventional dosage forms such as monophasic liquids, biphasic liquids, powders, suppositories and semisolids.

Course Outcomes

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

CO1. Know the history of the profession of pharmacy; the development of the IP and; introduction about BP, USP and Extra pharmacopoeia, various dosage forms, parts & procedure for handling the prescription.

CO2. Describe about the different dosage forms such as powders, monophasic and biphasic liquids, semisolids, pharmaceutical incompatibilities along with remedial measures, calculations related to child dose, weights and measures.

CO3. Apply skills in the pharmaceutical preparations such as powders, monophasic liquids, biphasic liquids and different types of semisolid dosage forms such as suppositories, ointments, pastes, creams and gels.

Course Content

Modules	Blooms level*	Number of hours
Module I: Historical background and development of profession of pharma-	L1, L2	10

cy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. Dosage forms: Introduction to dosage forms, classification and definitions Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription. Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.		
Module II: Pharmaceutical calculations: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques.	L1, L2	10
Module 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.	L1, L2	10
Module 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,	L1, L2	08

chemical and therapeutic incompatibilities with examples.		
Module 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.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

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CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2104	PHARMACEUTICAL INORGANIC CHEMISTRY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Comprehend various sources of impurities, limit test, test for purity and identification test.
2. Confer about buffers and buffered isotonic solutions.
3. Understand method of preparation, assay, storage and used of certain inorganic drugs and pharmaceuticals.
4. Perceive the significance of radioactivity and radioisotopes in the arena of pharmacy.

Course Outcomes

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

CO1. Perform limit test, test for purity and identification test for certain inorganic drugs and pharmaceuticals.

CO2. Explain buffers, buffer capacity, buffered isotonic solutions.

CO3. Explain the method of preparation, assay, storage conditions and uses of certain inorganic drugs and pharmaceuticals.

CO4. Describe radioactivity, radioisotopes and their pharmaceutical applications.

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2, L3	10

General methods of preparation , assay for the compounds superscripted with asterisk (*) , properties and medicinal uses of inorganic compounds belonging to the following classes.		
Module II: Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	L1, L2, L3	10
Module III: Gastrointestinal agents Acidifiers: Ammonium chloride* and Dil. HCl Antacid: Ideal properties of antacids, combinations of antacids, Sodium 40 Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations.	L1, L2	10
Module IV: Miscellaneous compounds Expectorants: Potassium iodide, Ammonium chloride*. Emetics: Copper sulphate*, Sodium potassium tartarate Haematinics: Ferrous sulphate*, Ferrous gluconate Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite333 Astringents: Zinc Sulphate, Potash Alum	L1, L2	08
Module V: Radiopharmaceuticals: Radio activity, Measurement of radioactivity,	L1, L2	07

Properties of α , β , γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2105	COMMUNICATION SKILLS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	2	0	0	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course outcomes

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

CO1. Explain behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation

CO2. Communicate in a group

CO3. Manage the team as a team player

Course Content

Modules	Blooms level*	Number of hours
Module I: Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context.	L1, L2	07

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.		
Module 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.	L1, L2	07
Module III: Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion Required, Shades of Meaning, Formal Communication. Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message.	L1, L2	07
Module IV: Interview Skills: Purpose of an interview, Do's and Dont's of an interview. Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.	L1, L2	05
Module V: Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion.	L1, L2	04

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Greenhall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt. ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
12. Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 1999

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	10	2	1	2	35

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
CO2	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
CO3	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1

1: strongly related, 2: moderately related and 3: weakly related

PHA 2106	HUMAN ANATOMY AND PHYSIOLOGY PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Explain the structure and functions of cardio, nervous, lymph, skin and skeletal muscles.

CO2. Describe the correlation of the body system with each other and their contributions towards homeostasis.

CO3. Identify the different type of tissue and bones, perform the quantitative analysis of blood cells.

Course Content

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.

Modules	Blooms level*	Number of hours
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List of experiments: 1. Study of compound microscope. 2. Microscopic study of epithelial and connective tissue 3. Microscopic study of muscular and nervous tissue 4. Identification of axial bones 5. Identification of appendicular bones 6. Introduction to hemocytometry. 7. Enumeration of white blood cell (WBC) count 8. Enumeration of total red blood corpuscles (RBC) count 9. Determination of bleeding time 10. Determination of clotting time 11. Estimation of hemoglobin content 12. Determination of blood group. 13. Determination of erythrocyte sedimentation rate (ESR). 14. Determination of heart rate and pulse rate. 15. Recording of blood pressure.	L1& L3	4 Hours / Week
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 Taylor. Williams & Wilkins Co, River-view, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 31
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

9. Physiological basis of Medical Practice-Best and Taylor. Williams & Wilkins Co, River-view, MI USA.

10. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.

11. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterje, Academic Publishers Kolkata.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	5	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2107	PHARMACEUTICAL ANALYSIS PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs.

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Carry out the preparation and standardization of various molar and normal solutions.

CO2. Apply the theory of acid base indicators in order to carry out the titrations of strong, weak, and very weak acids and bases.

CO3. Explain the various methods for precipitation titrations, complexometric titration and gravimetry.

CO4. Perform various types of redox titrations including cerimetry, iodimetry, iodometry, bromatometry, and dichrometry.

CO5. Determine the normality by electro-analytical methods such as conductometry and potentiometry.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I Limit Test of the following (1) Chloride	L3	4 Hours / Week

(2) Sulphate (3) Iron (4) Arsenic II Preparation and standardization of (1) Sodium hydroxide (2) Sulphuric acid (3) Sodium thiosulfate (4) Potassium permanganate (5) Ceric ammonium sulphate III Assay of the following compounds along with Standardization of Titrant (1) Ammonium chloride by acid base titration (2) Ferrous sulphate by Cerimetry (3) Copper sulphate by Iodometry (4) Calcium gluconate by complexometry (5) Hydrogen peroxide by Permanganometry (6) Sodium benzoate by non-aqueous titration (7) Sodium Chloride by precipitation titration IV Determination of Normality by electro-analytical methods (1) Conductometric titration of strong acid against strong base (2) Conductometric titration of strong acid and weak acid against strong base (3) Potentiometric titration of strong acid against strong base		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	5	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2108	PHARMACEUTICS PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Study the profession of Pharmacy- its history, scope and careers available, about pharmacopoeias and professional way of handling prescription.
2. Understanding the basics of different dosage forms, pharmaceutical incompatibilities and Pharmaceutical dose and relevant calculations.
3. Perform the preparation of various conventional dosage forms such as monophasic liquids, biphasic liquids, powders, suppositories and semisolids.

Course Outcomes

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

CO1. Know the history of the profession of pharmacy; the development of the IP and; introduction about BP, USP and Extra pharmacopoeia, various dosage forms, parts & procedure for handling the prescription.

CO2. Describe about the different dosage forms such as powders, monophasic and biphasic liquids, semisolids, pharmaceutical incompatibilities along with remedial measures, calculations related to child dose, weights and measures.

CO3. Apply skills in the pharmaceutical preparations such as powders, monophasic liquids, biphasic liquids and different types of semisolid dosage forms such as suppositories, ointments, pastes, creams and gels.

Course Content

Modules	Blooms level*	Number of hours
List of experiments:	L3	4 Hours /

1 . Syrups a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68 3 Hours / week 2. Elixirs a) Piperazine citrate elixir b) Paracetamol pediatric elixir 3.Linctus a) Terpin Hydrate Linctus IP'66 4. Solutions b) Iodine Throat Paint (Mandles Paint) 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) Cocoa butter suppository c) Zinc Oxide suppository 8. Semisolids a) Sulphur ointment b) Non staining-iodine ointment with methyl salicylate c) Carbopal gel 9. Gargles and Mouthwashes a) Iodine gargle b) Chlorhexidine mouthwash		Week
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	5	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2109	PHARMACEUTICAL INORGANIC CHEMISTRY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Comprehend various sources of impurities, limit test, test for purity and identification test.
2. Confer about buffers and buffered isotonic solutions.
3. Understand method of preparation, assay, storage and used of certain inorganic drugs and pharmaceuticals.
4. Perceive the significance of radioactivity and radioisotopes in the arena of pharmacy.

Course Outcomes

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

CO1. Perform limit test, test for purity and identification test for certain inorganic drugs and pharmaceuticals.

CO2. Explain buffers, buffer capacity, buffered isotonic solutions.

CO3. Explain the method of preparation, assay, storage conditions and uses of certain inorganic drugs and pharmaceuticals.

CO4. Describe radioactivity, radioisotopes and their pharmaceutical applications.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I– Limit tests for following ions Limit test for Chlorides and Sulphates Modified limit test for Chlorides and Sulphates	L3	4 Hours / Week

Limit test for Iron		
Limit test for Heavy-metals		
Limit test for Lead		
Limit test for Arsenic		
II– Identification test		
Magnesium hydroxide		
Ferrous sulphate		
Sodium bicarbonate		
Calcium gluconate		
Copper sulphate		
III– Test for purity		
Swelling power of Bentonite		
Neutralizing capacity of aluminum hydroxide gel		
Determination of potassium iodate and iodine in potassium Iodide		
IV– Preparation of inorganic pharmaceuticals		
Boric acid		
Potash alum		
Ferrous sulphate		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	5	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2110	COMMUNICATION SKILLS PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	2	1
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course outcomes

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

CO1. Explain behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation

CO2. Communicate in a group

CO3. Manage the team as a team player

Course Content

Modules	Blooms level*	Number of hours
The following learning modules are to be conducted using wordsworth® English language lab software Basic communication covering the following topics	L1&L3	2 Hours / week

Meeting People Asking Questions Making Friends What did you do? Do's and Dont's Pronunciations covering the following topics Pronunciation (Consonant Sounds) Pronunciation and Nouns Pronunciation (Vowel Sounds) Advanced Learning Listening Comprehension / Direct and Indirect Speech Figures of Speech Effective Communication Writing Skills Effective Writing Interview Handling Skills E-Mail etiquette Presentation Skills		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Greenhall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011
8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt. ltd, 2011
10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, 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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	03	02	03	05	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
CO2	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
CO3	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1

1: strongly related, 2: moderately related and 3: weakly related

PHA 2111	REMEDIAL MATHEMATICS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	0	0	3
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

2. Know the theory and their application in Pharmacy.
3. Solve the different types of problems by applying theory.
4. Appreciate the important application of mathematics in Pharmacy.

Course Outcomes

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

CO1. Apply mathematical concepts and principles to perform computations for Pharmaceutical Sciences.

CO2. Create, use and analyze mathematical representations and mathematical relationships.

CO3. Create, use and analyze mathematical representations and mathematical relationships.

CO4. Communicate mathematical knowledge and understanding to help in the field of Clinical Pharmacy.

CO5. Perform abstract mathematical reasoning.

Course Content

Modules	Blooms level*	Number of hours
Module I: Partial fraction Introduction, Polynomial, Rational fractions, Proper and Improper frac-	L1, L2	06

tions, 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 (n definition), $\lim_{x \rightarrow a} \frac{1}{x}$, $\lim_{x \rightarrow a} \frac{1}{x^2}$, $\lim_{x \rightarrow a} \sin x$, $\lim_{x \rightarrow a} \cos x$.		
Module 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 equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley-Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.	L1, L2, L3	06
Module 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.	L1, L2, L3	06
Module 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, Integra-	L1, L2, L3	06

tion by parts, definite integrals, application		
Module V: Differential Equations : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations. Laplace Transform : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, Application in solving Chemical kinetics and Pharmacokinetics equations.	L1, L2, L3	06

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	10	2	1	2	35

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2112	REMEDIAL BIOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	2	0	0	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Classify and salient features of five kingdoms of life

CO2. Write about the basic components of anatomy & physiology of plant

Course Content

Modules	Blooms level*	Number of hours
Module 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, Protista, Fungi, Animalia and Plantae, Virus, Morphology of Flowering plants: Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotyledons.	L1, L2	07
Module II:	L1, L2	07

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		
Module 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	L1, L2	07

Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle		
Module IV: Plants and mineral nutrition: Essential mineral, macro and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation Photosynthesis: Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	L1, L2	05
Module V: Plant respiration: Respiration, glycolysis, fermentation (anaerobic). Plant growth and development: Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators Cell - The Module of life: Structure and functions of cell and cell organelles. Cell division Tissues: Definition, types of tissues, location and functions.	L1, L2	04

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books (Latest Edition)

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

Text Books (Latest Edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	10	2	1	2	35

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2113	REMEDIAL BIOLOGY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	2	1
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Classify and salient features of five kingdoms of life

CO2. Write about the basic components of anatomy & physiology of plant

Course Content

Modules	Blooms level*	Number of hours
List of experiments: 1. Introduction to experiments in biology a) Study of Microscope b) Section cutting techniques c) Mounting and staining d) Permanent slide preparation 2. Study of cell and its inclusions 3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications 4. Detailed study of frog by using computer models 5. Microscopic study and identification of tissues pertinent to Stem, Root	L1 & L3	30 hours

Leaf, seed, fruit and flower		
6. Identification of bones		
7. Determination of blood group		
8. Determination of blood pressure		
9. Determination of tidal volume		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books (Latest Edition)

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

Text Books (Latest Edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	03	02	03	05	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Second Semester

PHA2201	Human Anatomy and Physiology-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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.

Course Outcomes

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

CO1. Demonstrate competency in Identifying the major structure and function of gross anatomy of Central Nervous System.

CO2. Discuss in depth the physiology of the Digestive, Respiratory and Urinary system from a regional perspective.

CO3. Describe briefly basic components and functions of Endocrine and Reproductive systems.

Course Content

Modules	Blooms level*	Number of hours
Module I: Nervous system: Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action	L1, L2	10

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).		
Module II: Digestive system: Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. Energetics: Formation and role of ATP, Creatinine Phosphate and BMR.	L1, L2	6
Module 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.	L1, L2	10
Module 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.	L1, L2	10
Module 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.	L1, L2	09

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brother's 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, River-view, MI USA.
4. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2202	PHARMACEUTICAL ORGANIC CHEMISTRY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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.

Course Objectives

The objective of this course is to

1. Understand the IUPAC names of organic compounds.
2. Demonstrate hybridization in alkanes and alkenes.
3. Predict the physical properties of organic chemicals based on their structures (e.g. relative boiling point and melting point).
4. Categorize the reactivity of certain class of organic compounds.
5. Represent the three-dimensional arrangement of atoms in space.

Course Outcomes

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

CO1. Describe the IUPAC nomenclature for simple organic compounds.

CO2. Carry-out systemic qualitative analysis of organic compounds.

CO3. Explain the physical properties of organic chemicals.

CO4. Enumerate the principles of reaction mechanism in the synthesis of organic compounds.

CO5. Visualize simple organic compound using molecular model kit.

Course Content

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

Modules	Blooms level*	Number of hours
Module 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.	L1, L2, L3	07
Module II: Alkanes*, Alkenes* and Conjugated dienes*: SP ³ hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP ² hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 versus E2 reactions, Factors affecting E1 and E2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation. Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement.	L1, L2	10
Module III: Alkyl halides*: SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. Alcohols*: Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol.	L1, L2	10
Module 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.	L1, L2	10
Module 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	L1, L2, L3	08

Aliphatic amines*: Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 Ahluwalia/Chatwal.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2203	BIOCHEMISTRY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Understand biological role and metabolism of carbohydrates, lipids and amino acids and bioenergetics.
2. Recall Nucleic acid metabolism and genetic information transfer.
3. Know about enzymes, classification, kinetics, regulation and applications.
4. Identify and determine carbohydrates, proteins, cholesterol in blood and urine and their significance in diagnosis of diseases.

Course Outcomes

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

CO1. Describe biological role and metabolism of carbohydrates, lipids and amino acids and bioenergetics.

CO2. Explain Nucleic acid metabolism and genetic information transfer.

CO3. Explain enzymes, classification, kinetics, regulation and applications.

CO4. Perform identification and determination of carbohydrates, proteins, cholesterol in blood and urine and their significance in diagnosis of diseases.

Course Content

Modules	Blooms level*	Number of hours
Module I:	L1, L2	08

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.		
Module II: Carbohydrate metabolism: Glycolysis – Pathway, energetics and significance; Citric acid cycle- Pathway, energetics and significance; HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency; Glycogen metabolism Pathways and glycogen storage diseases (GSD); Gluconeogenesis- Pathway and its significance; Hormonal regulation of blood glucose level and Diabetes mellitus. Biological oxidation: Electron transport chain (ETC) and its mechanism. Oxidative phosphorylation & its mechanism and substrate phosphorylation Inhibitors ETC and oxidative phosphorylation/Uncouplers level.	L1, L2	10
Module 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 (Phenylketonuria, Albinism, alcaptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice.	L1, L2	10
Module 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.	L1, L2	10
Module 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	L1, L2	07

induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes Coenzymes – Structure and biochemical functions.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2204	PATHOPHYSIOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Describe the etiology and pathogenesis of the selected disease states.

CO2. Knowledge of signs and symptoms of the diseases.

CO3. Identify the complications of the diseases.

CO4. Know most commonly encountered pathophysiological state(s) and/or disease mechanism(s), as well as any clinical testing requirements.

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	10

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.		
Module 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.	L1, L2	10
Module III: Haematological Diseases: Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. Gastrointestinal system: Peptic Ulcer	L1, L2	10
Module 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	L1, L2	08

Cancer		
Module V: Infectious diseases: Meningitis, Typhoid, Leprosy, Tuberculosis Urinary tract infections Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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; Moduleed 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.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
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Weightage (%)	15	3	3	4	75
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CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2205	COMPUTER APPLICATIONS IN PHARMACY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	0	0	3
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Know the various types of application of computers in pharmacy.
2. Know the various types of databases; and
3. Know the various applications of databases in pharmacy.

Course Outcomes

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

CO1. Apply the knowledge of mathematics and computing fundamentals to pharmaceutical Applications for any given requirement.

CO2. Design and develop solutions to analyze pharmaceutical problems using computers.

CO3. Integrate and apply efficiently the contemporary IT tools to all pharmaceutical related activities.

CO4. Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy.

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	06

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.		
Module II: Web technologies: Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database.	L1, L2	06
Module 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.	L1, L2	06
Module IV: Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery.	L1, L2	06
Module V: Computers as data analysis in Preclinical development: Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS).	L1, L2	06

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	50

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2206	ENVIRONMENTAL SCIENCES	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	0	0	3
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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.

Course Outcomes

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

CO1. This program shall create awareness about environmental problems, develop an attitude towards of concern for the environment.

Course Content

Modules	Blooms level*	Number of hours
Module 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 re-	L1, L2	10

sources; f) Land resources: Role of an individual in conservation of natural resources.		
Module II: Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	L1, L2	10
Module III: Environmental Pollution: Air pollution; Water pollution; Soil pollution	L1, L2	10

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	50

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2207	HUMAN ANATOMY AND PHYSIOLOGY PRACTICAL-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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.

Course Outcomes

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

CO1. Demonstrate competency in Identifying the major structure and function of gross anatomy of Central Nervous System.

CO2. Discuss in depth the physiology of the Digestive, Respiratory and Urinary system from a regional perspective.

CO3. Describe briefly basic components and functions of Endocrine and Reproductive systems.

Course Content

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.

Modules	Blooms	Number
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	level*	of hours
List of experiments: 1. To study the integumentary and special senses using specimen, models, etc., 2. To study the nervous system using specimen, models, etc., 3. To study the endocrine system using specimen, models, etc 4. To demonstrate the general neurological examination 5. To demonstrate the function of olfactory nerve 6. To examine the different types of taste. 7. To demonstrate the visual acuity 8. To demonstrate the reflex activity 9. Recording of body temperature 10. To demonstrate positive and negative feedback mechanism. 11. Determination of tidal volume and vital capacity. 12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens. 13. Recording of basal mass index. 14. Study of family planning devices and pregnancy diagnosis test. 15. Demonstration of total blood count by cell analyser 16. Permanent slides of vital organs and gonads.	L1& L3	4 Hours/w eeek

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brother's 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, River-view, MI USA.
4. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.

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

Reference Books

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	5	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2208	PHARMACEUTICAL ORGANIC CHEMISTRY PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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.

Course Objectives

The objective of this course is to

1. Understand the IUPAC names of organic compounds.
2. Demonstrate hybridization in alkanes and alkenes.
3. Predict the physical properties of organic chemicals based on their structures (e.g. relative boiling point and melting point).
4. Categorize the reactivity of certain class of organic compounds.
5. Represent the three-dimensional arrangement of atoms in space.

Course Outcomes

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

CO1. Describe the IUPAC nomenclature for simple organic compounds.

CO2. Carry-out systemic qualitative analysis of organic compounds.

CO3. Explain the physical properties of organic chemicals.

CO4. Enumerate the principles of reaction mechanism in the synthesis of organic compounds.

CO5. Visualize simple organic compound using molecular model kit.

Course Content

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

Modules	Blooms level*	Number of hours
List of experiments: 1. Systematic qualitative analysis of unknown organic compounds like 1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc. 2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test 3. Solubility test 4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides. 5. Melting point/Boiling point of organic compounds 6. Identification of the unknown compound from the literature using melting point/ boiling point. 7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point. 8. Minimum 5 unknown organic compounds to be analysed systematically. 2. Preparation of suitable solid derivatives from organic compounds 3. Construction of molecular models	L3	4 Hours / week

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2209	BIOCHEMISTRY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Understand biological role and metabolism of carbohydrates, lipids and amino acids and bioenergetics.
2. Recall Nucleic acid metabolism and genetic information transfer.
3. Know about enzymes, classification, kinetics, regulation and applications.
4. Identify and determine carbohydrates, proteins, cholesterol in blood and urine and their significance in diagnosis of diseases.

Course Outcomes

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

CO1. Describe biological role and metabolism of carbohydrates, lipids and amino acids and bioenergetics.

CO2. Explain Nucleic acid metabolism and genetic information transfer.

CO3. Explain enzymes, classification, kinetics, regulation and applications.

CO4. Perform identification and determination of carbohydrates, proteins, cholesterol in blood and urine and their significance in diagnosis of diseases.

Course Content

Modules	Blooms level*	Number of hours
List of experiments:	L1&	4 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.	L3	Week
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA	EE
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Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	2	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2210	COMPUTER APPLICATIONS IN PHARMACY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	2	1
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Know the various types of application of computers in pharmacy.
2. Know the various types of databases; and
3. Know the various applications of databases in pharmacy.

Course Outcomes

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

CO1. Apply the knowledge of mathematics and computing fundamentals to pharmaceutical Applications for any given requirement.

CO2. Design and develop solutions to analyze pharmaceutical problems using computers.

CO3. Integrate and apply efficiently the contemporary IT tools to all pharmaceutical related activities.

CO4. Solve and work with a professional context pertaining to ethics, social, cultural and regulations with regard to Pharmacy.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: 1. Design a questionnaire using a word processing package to gather information about a particular disease. 2. Create a HTML web page to show personal information. 3 Retrieve the information of a drug and its adverse effects using online tools	L3	2 hr/week

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		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 Wiley 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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	03	02	03	05	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--

CO2	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	2	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Third Semester

PHA2301	PHARMACEUTICAL ORGANIC CHEMISTRY-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Write the structure, name and the type of isomerism of the organic compound
2. Write the reaction, name the reaction and orientation of reactions
3. Account for reactivity/stability of compounds,
4. Prepare organic compounds

Course Outcomes

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

CO1. Analyze the chemistry of fats and oils.

CO2. Perform the synthesis of prescribed compounds.

CO3. Perform distillation and recrystallization of the synthesized compounds.

Course Content

Modules	Blooms level*	Number of hours
Module I: Benzene and its derivatives A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule B. Reactions of benzene - nitration, sulphonation, halogenationreactivi-	L1, L2, L3	10

ty, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation. C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction D. Structure and uses of DDT, Saccharin, BHC and Chloramine		
Module 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.	L1, L2, L3	10
Module III: Fats and Oils a. Fatty acids – reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	L1, L2	10
Module IV: Polynuclear hydrocarbons: a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives.	L1, L2	08
Module V: Cyclo alkanes* Stabilities – Baeyer’s strain theory, limitation of Baeyer’s strain theory, Coulson and Moffitt’s modification, Sachse Mohr’s theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.	L1, L2	07

**Bloom’s Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2302	PHYSICAL PHARMACEUTICS-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Determine the solubility of drugs, factors influencing solubility of drugs, ideal solutions and real solutions, Critical solution temperature, phase rule, distribution law.

CO2. Know the conversion process in the state of matter i.e., one form to other and to determine the physicochemical properties of drug molecules like refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant.

CO3. Determine the particle size, surface area, and derived properties of powders.

CO4. Complexation mechanisms and analysis methods.

CO5. Concepts of pH, pKa, buffers, isotonic solutions.

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1, L2	10
Module II: States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solid crystalline, amorphous & polymorphism. Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	L1, L2	10
Module 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.	L1, L2	10
Module 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.	L1, L2	08
Module 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.	L1, L2	07

*Bloom's Level:

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2303	PHARMACEUTICAL MICROBIOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Identify, isolate and cultivate microorganisms.

CO2. Explore sterilization protocols used in microbiology and sterility testing of pharmaceutical products.

CO3. Evaluate the sterility testing of pharmaceutical products.

CO4. Illustrate the production of antibiotics, vitamins and various fermented products by fermentation technology.

CO5. Use appropriate methods to obtain effective microbiological quality control of sterilization, preservation & disinfection and assessment of microbial contamination of pharmaceutical products.

CO6. Elaborate the cell culture technique and its applications in pharmaceutical industries.

Course Content

Modules	Blooms level*	Number of hours
Module 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 contrast microscopy, dark field microscopy and electron microscopy.	L1, L2	10
Module II: Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators.	L1, L2	10
Module 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.	L1, L2	10
Module 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.	L1, L2	08
Module 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,	L1, L2	07

general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO6	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2304	PHARMACEUTICAL ENGINEERING	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Perform unit operations used in Pharmaceutical industries

CO2. Handling of different using different material handling techniques

CO3. Designing of plant lay out for optimum use of resources

Course Content

Modules	Blooms level*	Number of hours
Module I: Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice	L1, L2, L3	10

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.		
Module II: Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator. Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation	L1, L2, L3	10
Module 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	L1, L2, L3	10
Module IV: Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working,	L1, L2, L3	08

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.		
Module 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.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2305	PHARMACEUTICAL ORGANIC CHEMISTRY PRACTICAL-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject deals with general methods of preparation and reactions of some organic compounds along with their definition, types, classification, principles/mechanisms, applications, examples and differences. Reactivity of organic compounds would be discussed. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus

Course Objectives

The objective of this course is to

1. Students learnt about the physical and chemical properties of the aromatic compounds, different types of reactions that could be performed on benzene and its derivatives
2. Make students learn about the laboratory synthetic methodologies of various aromatic compounds

Course Outcomes

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

CO 1. Write the structure, name and the type of isomerism of the organic compound

CO 2. Write the reaction, name the reaction and orientation of reactions

CO 3. Account for reactivity/stability of compounds,

CO 4. How to proceed for the synthesis of organic compounds

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I– Experiments involving laboratory techniques 1. Recrystallization 2. Steam distillation II-Determination of following oil values (including standardization of reagents) 1. Acid value	L3	4 Hours / Week

2. Saponification value 3. Iodine value		
III– Preparation of compounds		
1. Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction. 2. 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ 3. Acetanilide by halogenation (Bromination) reaction. 4. 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction. 5. Benzoic acid from Benzyl chloride by oxidation reaction. 6. Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction. 7. 1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions. 8. Benzil from Benzoin by oxidation reaction. 9. Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction 10. Cinnamic acid from Benzaldehyde by Perkin reaction 11. <i>P</i> -Iodo benzoic acid from <i>P</i> -amino benzoic acid		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA	EE
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Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2306	PHYSICAL PHARMACEUTICS PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Determine the solubility of drugs, factors influencing solubility of drugs, ideal solutions and real solutions, Critical solution temperature, phase rule, distribution law.

CO2. Know the conversion process in the state of matter i.e., one form to other and to determine the physicochemical properties of drug molecules like refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant.

CO3. Determine the particle size, surface area, and derived properties of powders.

CO4. Complexation mechanisms and analysis methods.

CO5. Concepts of pH, pKa, buffers, isotonic solutions.

Course Content

Modules	Blooms level*	Number of hours
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List of experiments: 1. Determination the solubility of drug at room temperature 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation. 3. Determination of Partition co- efficient of benzoic acid in benzene and water 4. Determination of Partition co- efficient of Iodine in CCl₄ and water 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method 6. Determination of surface tension of given liquids by drop count and drop weight method 7. Determination of HLB number of a surfactant by saponification method 8. Determination of Freundlich and Langmuir constants using activated 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	L3	4 Hrs/week
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 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. LaboratoryManual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2307	PHARMACEUTICAL MICROBIOLOGY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Identify, isolate and cultivate microorganisms.

CO2. Explore sterilization protocols used in microbiology and sterility testing of pharmaceutical products.

CO3. Evaluate the sterility testing of pharmaceutical products.

CO4. Illustrate the production of antibiotics, vitamins and various fermented products by fermentation technology.

CO5. Use appropriate methods to obtain effective microbiological quality control of sterilization, preservation & disinfection and assessment of microbial contamination of pharmaceutical products.

CO6. Elaborate the cell culture technique and its applications in pharmaceutical industries.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: 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.	L1&L3	4 Hours / Week

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest edition)

14. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
15. Prescott and Dunn, Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
16. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
17. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
18. Rose: Industrial Microbiology.
19. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
20. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
21. Peppler: Microbial Technology.
22. I.P., B.P., U.S.P.- latest editions.

23. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
24. Edward: Fundamentals of Microbiology.
25. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
26. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO6	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2308	PHARMACEUTICAL ENGINEERING PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Comprehend various operations employed in pharmaceutical industry .
2. Confer about classification of various equipments used in pharmaceutical engineering.
3. Understand procedure of preparation and uses of various dosage forms.
4. Perceive the significance of various pharmaceutical techniques used in the arena of pharmacy.

Course Outcomes

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

CO1. Perform various unit operations involved in preparation of dosage forms.

CO2. Explain classification & uses of various methods employed.

CO3. Explain the advantages & disadvantages of using different unit operations.

CO4. Describe the various parts of an equipment.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I. Determination of radiation constant of brass, iron, unpainted and painted glass. II. Steam distillation – To calculate the efficiency of steam distillation. III. To determine the overall heat transfer coefficient by heat exchanger.	L3	4 Hours / Week

IV. Construction of drying curves (for calcium carbonate and starch). V. Determination of moisture content and loss on drying. VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method. VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier. VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots. IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill. X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other-major equipment. XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/viscosity XII. To study the effect of time on the Rate of Crystallization. XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceuticals- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Fourth Semester

PHA2401	PHARMACEUTICAL ORGANIC CHEMISTRY-III	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Understand the methods of preparation and properties of organic compounds.
2. Explain the stereo chemical aspects of organic compounds and stereo chemical reactions.
3. Know the medicinal uses and other applications of organic compounds.

Course Outcomes

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

CO1. To acquire the knowledge and understanding of the basic experimental principles of heterocyclic chemistry.

CO2. To draw the structures and synthesize simple pharmaceutically active organic compounds having five and six membered heterocyclic compounds.

CO3. To describe detailed mechanisms for common naming reactions.

CO4. To be able to run experimental techniques, procedures and safe laboratory practices.

CO5. Stereo-chemical features including conformation and stereo electronic effects; Geometrical isomers.

Course Content

Modules	Blooms level*	Number of hours
Module I: Stereo isomerism: Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds. Elements of symmetry, chiral and achiral molecules. DL system of nomenclature of optical	L1, L2, L3	10

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.		
Module 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	L1, L2, L3	10
Module 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.	L1, L2	10
Module 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	L1, L2	08
Module 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	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

9. Organic chemistry by I.L. Finar, Volume-I & II.
10. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
11. Heterocyclic Chemistry by Raj K. Bansal
12. Organic Chemistry by Morrison and Boyd
13. Heterocyclic Chemistry by T.L. Gilchrist

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2402	MEDICINAL CHEMISTRY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

- CO1. Helps in correlating between pharmacology of a disease and its mitigation or cure
- CO2. To understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
- CO3. To know the structural activity relationship of different class of drugs
- CO4. Well acquainted with the synthesis of some important class of drugs
- CO5. Knowledge about the mechanism pathways of different class of medicinal compounds
- CO6. To understand the chemistry of drugs with respect to their pharmacological activity

Course Content

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

Modules	Blooms level*	Number of hours
Module I: Introduction to Medicinal Chemistry History and development of medicinal chemistry Physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. Drug metabolism Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereo chemical aspects.	L1, L2	10
Module 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.	L1, L2	10
Module 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, Isofluorophate, Echothiophate iodide, Parathione, Malathion. Cholinesterase reactivator: Pralidoxime chloride. Cholinergic Blocking agents: SAR of cholinolytic agents	L1, L2	10

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.		
Module IV: Drugs acting on Central Nervous System A. Sedatives and Hypnotics: Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem Barbiturates: SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital Miscellaneous: Amides & imides: Glutethimide. Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. B. Antipsychotics Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. Fluorobutyrophenones: Haloperidol, Droperidol, Risperidone. Beta amino ketones: Molindone hydrochloride. Benzamides: Sulpieride. C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action Barbiturates: Phenobarbital, Methobarbital. Hydantoins: Phenytoin*, Mephénytoin, Ethotoin Oxazolidine diones: Trimethadione, Paramethadione Succinimides: Phensuximide, Methsuximide, Ethosuximide* Urea and monoacylureas: Phenacemide, Carbamazepine* Benzodiazepines: Clonazepam Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate	L1, L2	08
Module V: Drugs acting on Central Nervous System General anesthetics: Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.	L1, L2	07

Ultra short acting barbiturates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium. Dissociative anesthetics: Ketamine hydrochloride.* Narcotic and non-narcotic analgesics Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride. Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
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Weightage (%)	15	3	3	4	75
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CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--
CO6	1	--	1	2	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2403	PHYSICAL PHARMACEUTICS-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. State the physicochemical properties of drug molecules, pH, and solubility

CO2. Explain the role of surfactants, interfacial phenomenon and thermodynamics

CO3. Analyze the chemical stability tests of various drug products

CO4. Understand the physical properties of solutions, buffers, isotonicity, disperse systems and rheology

CO5. Understand of physicochemical properties of drugs including solubility, distribution, adsorption, and stability

Course Content

Modules	Blooms level*	Number of hours
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Module 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.	L1, L2	07
Module 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	L1, L2	10
Module 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.	L1, L2	10
Module IV: Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	L1, L2	10
Module V: Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, Modules 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.	L1, L2	08

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2404	PHARMACOLOGY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Students would have understood the pharmacological actions of different categories of drugs

CO2. They would have studied in detailed about mechanism of drug action at organ system/sub cellular/ macromolecular levels.

CO3. They would have understood the application of basic pharmacological knowledge in the prevention and treatment of various diseases

CO4. They would have observed the effect of drugs on animals by simulated experiments

CO5. They would have understood the signal transduction mechanism of various receptors

Course Content

Modules	Blooms level*	Number of hours
Module I: 1. General Pharmacology a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination	L1, L2, L3	08
Module II: General Pharmacology a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action. b. Adverse drug reactions. c. Drug interactions (pharmacokinetic and pharmacodynamic) d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	L1, L2, L3	12
Module III: 2. Pharmacology of drugs acting on peripheral nervous system a. Organization and function of ANS. b. Neurohumoral transmission, co-transmission and classification of neurotransmitters. c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).	L1, L2	10

e. Local anesthetic agents.		
f. Drugs used in myasthenia gravis and glaucoma		
Module IV: 3. Pharmacology of drugs acting on central nervous system a. Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anesthetics and pre-anesthetics. c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics e. Alcohols and disulfiram	L1, L2	08
Module V: 3. Pharmacology of drugs acting on central nervous system a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. b. Drugs used in Parkinson's disease and Alzheimer's disease. c. CNS stimulants and nootropics. d. Opioid analgesics and antagonists e. Drug addiction, drug abuse, tolerance and dependence.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology
6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2405	PHARMACOGNOSY AND PHYTO-CHEMISTRY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Explain about the Herbs, and their Science

CO2. Determine that how herbs influence our physiology and can be helpful against several disorders

CO3. Relate between Phyto -therapy and the Elderly, Phytotherapy and Children, Understanding Herbal Action, and Understanding the Materia Medica

CO4. Recognise of medicinal plants, identification of adulteration and Contamination

CO5. Explain Ethnobotany & Ethnopharmacology in drug discovery process

Course Content

Modules	Blooms level*	Number of hours
Module I: Introduction to Pharmacognosy:	L1, L2, L3	10

(a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs Quality control of Drugs of Natural Origin: Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida		
Module 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	L1, L2	10
Module 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	L1, L2	07
Module IV: Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medi-	L1, L2	10

cine 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		
Module V: Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs Plant Products: Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primarymetabolites: 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	L1, L2	08

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, 1st edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhale
9. Anatomy of Crude Drugs by M.A. Iyengar

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	2	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	2	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	2	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	2	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	2	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2406	MEDICINAL CHEMISTRY PRACTICAL – I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. To impart the knowledge and concept of medicinal chemistry upon students
2. To make students learnt about various synthetic methodologyclasses of drugs, their SAR (Structure Activity Relationship), mechanism of action and synthesis

Course Outcomes

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

CO 1. Write chemistry of drugs with respect to their pharmacological activity

CO 2. Explain the drug metabolic pathways, adverse effect and therapeutic value of drugs

CO 3. Relate the Structure Activity Relationship (SAR) of different class of drugs

CO 4. Perform the chemical synthesis of some drugs in laboratory

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I Preparation of drugs/ intermediates 1. 1,3-pyrazole 2. 1,3-oxazole 3. Benzimidazole 4. Benztriazole 5. 2,3- diphenyl quinoxaline 6. Benzocaine 7. Phenytoin 8. Phenothiazine 9. Barbiturate	L3	4 Hours / Week

II Assay of drugs 1. Chlorpromazine 2. Phenobarbitone 3. Atropine 4. Ibuprofen 5. Aspirin 6. Furosemide III Determination of Partition coefficient for any two drugs		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2407	PHYSICAL PHARMACEUTICS PRACTICAL –II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. State the physicochemical properties of drug molecules, pH, and solubility

CO2. Explain the role of surfactants, interfacial phenomenon and thermodynamics

CO3. Analyze the chemical stability tests of various drug products

CO4. Understand the physical properties of solutions, buffers, isotonicity, disperse systems and rheology

CO5. Understand of physicochemical properties of drugs including solubility, distribution, adsorption, and stability

Course Content

Modules	Blooms level*	Number of hours
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List of experiments: 1. Determination of particle size, particle size distribution using sieving method 2. Determination of particle size, particle size distribution using Microscopic method 3. Determination of bulk density, true density and porosity 4. Determine the angle of repose and influence of lubricant on angle of repose 5. Determination of viscosity of liquid using Ostwald's viscometer 6. Determination sedimentation volume with effect of different suspending agent 7. Determination sedimentation volume with effect of different concentration of single suspending agent 8. Determination of viscosity of semisolid by using Brookfield viscometer 9. Determination of reaction rate constant first order. 10. Determination of reaction rate constant second order 11. Accelerated stability studies	L3	4 Hours / Week
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2408	PHARMACOLOGY PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Students would have understood the pharmacological actions of different categories of drugs

CO2. They would have studied in detailed about mechanism of drug action at organ system/sub cellular/ macromolecular levels.

CO3. They would have understood the application of basic pharmacological knowledge in the prevention and treatment of various diseases

CO4. They would have observed the effect of drugs on animals by simulated experiments

CO5. They would have understood the signal transduction mechanism of various receptors

Course Content

Modules	Blooms level*	Number of hours
List of experiments: 1. Introduction to experimental pharmacology. 2. Commonly used instruments in experimental pharmacology. 3. Study of common laboratory animals. 4. Maintenance of laboratory animals as per CPCSEA guidelines. 5. Common laboratory techniques. Blood withdrawal, serum and plasma separation anesthetics and euthanasia used for animal studies. 6. Study of different routes of drugs administration in mice/rats. 7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice. 8. Effect of drugs on ciliary motility of frog oesophagus 9. Effect of drugs on rabbit eye. 10. Effects of skeletal muscle relaxants using rota-rod apparatus. 11. Effect of drugs on locomotor activity using actophotometer. 12. Anticonvulsant effect of drugs by MES and PTZ method. 13. Study of stereotype and anti-catatonic activity of drugs on rats/mice. 14. Study of anxiolytic activity of drugs using rats/mice. 15. Study of local anesthetics by different methods <i>Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos</i>	L1& L3	4 Hours / Week

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert,
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO5	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2409	PHARMACOGNOSY AND PHYTO-CHEMISTRY PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Explain about the Herbs, and their Science

CO2. Determine that how herbs influence our physiology and can be helpful against several disorders

CO3. Relate between Phyto -therapy and the Elderly, Phytotherapy and Children, Understanding Herbal Action, and Understanding the Materia Medica

CO4. Recognise of medicinal plants, identification of adulteration and Contamination

CO5. Explain Ethnobotany & Ethnopharmacology in drug discovery process

Course Content

Modules	Blooms level*	Number of hours
List of experiments: 1. Analysis of crude drugs by chemical tests: (i) Tragacanth (ii) Acacia	L3	4 Hours / Week

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

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), 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 byM.A. Iyengar

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA	EE
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Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO4	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO5	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Fifth Semester

PHA2501	MEDICINAL CHEMISTRY-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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. Study the chemical synthesis of some drugs.

Course Outcomes

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

- CO1. Draw correlation between pharmacology of a disease and its mitigation or cure
- CO2. Explain the drug metabolic pathways, adverse effect and therapeutic value of drugs
- CO3. Describe the structural activity relationship of different class of drugs
- CO4. Write the synthesis of some important class of drugs

Course Content

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

Modules	Blooms level*	Number of hours
Module I: Antihistaminic agents: Histamine, receptors and their distribution in	L1, L2	10

the human body H1-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium H2-antagonists: Cimetidine*, Famotidine, Ranitidine Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole Anti-neoplastic agents: Alkylating agents: Mecllorethamine*, 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.		
Module II: Anti-anginal: Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. Diuretics: Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.	L1, L2	10

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.		
Module 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, Cholestamine and Cholestipol Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.	L1, L2	10
Module IV: Drugs acting on Endocrine system Nomenclature, Stereochemistry and metabolism of steroids Sex hormones: Testosterone, Nandrolone, Progestones, Oestriol, Oestradiol, Oestrone, Diethyl stilbestrol. Drugs for erectile dysfunction: Sildenafil, Tadalafil. Oral contraceptives: Mifepristone, Norgestrel, Levonorgestrel Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	L1, L2	08
Module V: Antidiabetic agents: Insulin and its preparations Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride.	L1, L2	07

Biguanides: Metformin.		
Thiazolidinediones: Pioglitazone, Rosiglitazone.		
Meglitinides: Repaglinide, Nateglinide.		
Glucosidase inhibitors: Acarbose, Voglibose.		
Local Anesthetics: SAR of Local anesthetics		
Benzoic Acid derivatives; Cocaine, Hexylcaine, Mepylcaine, Cyclo-methylcaine, Piperocaine.		
Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.		
Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.		
Miscellaneous: Phenacaine, Dipreron, Dibucaine.*		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Wilson and Gisvold's Organic medicinal and Pharmaceutical Chemistry, 12th edition, Lippincott Williams and Wilkins, **2018**, ISBN: 9788184733969, 9788184733969,
2. Foye's Principles of Medicinal Chemistry, 8/E (English, Paperback, Thomas L. Lemke Victoria F. Roche, S. William Zito, **2019**, ISBN: 9789389335798, 9789389335798

Reference Books

3. Burger's Medicinal Chemistry, Vol I to IV, **2003**, John Wiley and Sons Ltd, **ISBN 0-471-27090-3**
1. Martindale's extra pharmacopoeia, English, Paperback, Westcott William Wynn, ISBN: 9780341858188, 0341858188

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--
CO2	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--
CO3	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--
CO4	1	1	--	--	--	--	--	--	--	--	--	--	2	1	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2502	INDUSTRIAL PHARMACY-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Develop concepts for various techniques involved in manufacturing several drug dosage forms.
2. Make students understand about physicochemical properties, quality and stability of drugs and drug products.

Course Outcomes

On completion of this course, the 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.

Modules	Blooms level*	Number of hours
MODULE 1: Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization, BCS classification of drugs & its significant, Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	L1, L2, L3	7
MODULE 2:	L1, L2,	10

Tablets: Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. Tablet coating: Types of coating, coating materials, formulation of coating, composition, methods of coating, equipment employed and defects in coating. 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.	L3	
MODULE 3: Capsules: Hard gelatin capsules: Introduction, Production of hard gelatin capsule shells. Size, of capsules, Filling, finishing and special techniques of formulation of hard gelatine capsules, manufacturing defects. In process and final product quality control tests for capsules. 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.	L1, L2, L3	8
MODULE 4: Parenteral Products: Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity, Production procedure, production facilities and controls, aseptic processing. 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.	L1, L2, L3	10
MODULE 5: 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.	L1, L2, L3	10

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Physical Pharmacy and Pharmaceutical Sciences by Alfred Martin, Lippincott Williams and Wilkins Publishers.
2. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz.
3. Tutorial Pharmacy by Cooper and Gunn, Edited by S. J. Carter.
4. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman.
5. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition.
6. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Sciences (RPS).

Reference Books

1. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition.
2. Theory and Practice of Industrial Pharmacy by Liberman & Lachman.
3. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005.
4. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Marcel Dekkar Inc.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO2	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO3	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2503	PHARMACOLOGY-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject imparts 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 in addition to emphasis on the basic concepts of bioassay.

Course Objectives

The objective of this course is to

1. Explain and equip students about the mechanism of different drugs on various organ/tissue systems in different diseases.
2. Make student understand about the involvement of various receptor/enzymes/proteins involved in these phenomena.

Course Outcomes

On completion of this course, the 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.

CO4: Appreciate correlation of pharmacology with related medical sciences.

Modules	Blooms level*	Number of hours
MODULE 1: Pharmacology of drugs acting on cardio vascular system Introduction to hemodynamic and electrophysiology of heart, Drugs used in congestive heart failure, Anti-hypertensive drugs, Anti-anginal drugs, Anti-arrhythmic drugs, Anti-hyperlipidemic drugs.	L1, L2, L3	10
MODULE 2: Pharmacology of drugs acting on cardio vascular system: Drug used in the therapy of shock, Hematinics, coagulants and anticoagu-	L1, L2, L3	10

lants, Fibrinolytics and anti-platelet drugs, Plasma volume expanders. Pharmacology of drugs acting on urinary system: Diuretics, Anti-diuretics.		
MODULE 3: Autocoids and related drugs Introduction to autocoids and classification, Histamine, 5-HT and their antagonists, Prostaglandins, Thromboxanes and Leukotrienes, Angiotensin, Bradykinin and Substance P, Non-steroidal anti-inflammatory agents, Anti-gout drugs, Antirheumatic drugs	L1, L2, L3	10
MODULE 4: Pharmacology of drugs acting on endocrine system Basic concepts in endocrine pharmacology, Anterior Pituitary hormones- analogues and their inhibitors, Thyroid hormones- analogues and their inhibitors, Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D, Insulin, Oral Hypoglycemic agents and glucagon, ACTH and corticosteroids.	L1, L2, L3	8
MODULE 5: Pharmacology of drugs acting on endocrine system Androgens and Anabolic steroids, Estrogens, progesterone and oral contraceptives, Drugs acting on the uterus. Bioassay Principles and applications of bioassay, Types of bioassay, Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT	L1, L2, L3	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher.
2. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
3. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
4. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Reference Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier.
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO2	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO3	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO4	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2504	PHARMACOGNOSY AND PHYTOCHEMISTRY-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

Upon the successful completion of this course; the students will have the knowledge about:

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

Course Outcomes

After successful completion of this course, the student will be able to

CO1: Describe various methods for the identification and isolation of phytoconstituents and their properties.

CO2: Demonstrate the use of medicinal plant and its industrial importance

CO3: Illustrate various pharmacognostic parameters of crude drugs.

Modules	Blooms level*	Number of hours
Module I: Metabolic pathways in higher plants and their determination a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of	L1, L2 and L3	7

Biogenetic studies.		
Module II: General introduction, composition, chemistry & chemical classes, general methods of extraction & analysis, biosources, therapeutic uses and commercial applications of following secondary metabolites: Alkaloids: Vinca, Rauwolfia, Belladonna, Opium, Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander	L1 and L2	10
Module III: General introduction, composition, chemistry & chemical classes, general methods of extraction & analysis, biosources, therapeutic uses and commercial applications of following secondary metabolites: Tannins: Catechu, Pterocarpus Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony Glycosides: Senna, Aloes, Bitter Almond Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids	L1 and L2	10
Module IV: Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	L1 and L2	10
Module V: Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	L1, L2 and L3	8

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New

Delhi.

5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007

Reference Books

1. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
2. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
3. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
4. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
5. The formulation and preparation of cosmetic, fragrances and flavours.
6. Remington's Pharmaceutical sciences.
7. Text Book of Biotechnology by Vyas and Dixit.
8. Text Book of Biotechnology by R.C. Dubey.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	Attd	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2505	PHARMACEUTICAL JURISPRUDENCE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Contribute into Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.

CO2. Contribute into regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

CO3. Apply code of ethics during the pharmaceutical practice

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	10

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.		
Module II: Drugs and Cosmetics Act, 1940 and its rules 1945. Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties. Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors	L1, L2	10
Module 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	L1, L2	10

Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties		
Module 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).	L1, L2	08
Module 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 Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath Medical Termination of Pregnancy Act Right to Information Act Introduction to Intellectual Property Rights (IPR)	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-by M.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.

7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2506	INDUSTRIAL PHARMACY PRACTICAL-I	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Develop concepts for various techniques involved in manufacturing several drug dosage forms.
2. Make students understand about physicochemical properties, quality and stability of drugs and drug products.

Course Outcomes

On completion of this course, the 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.

Course content

Modules	Blooms level*	Number of hours
List of experiments: 1. Preformulation studies on paracetamol/asparin/or any other drug 2. Preparation and evaluation of Paracetamol tablets 3. Preparation and evaluation of Aspirin tablets 4. Coating of tablets- film coating of tables/granules 5. Preparation and evaluation of Tetracycline capsules 6. Preparation of Calcium Gluconate injection 7. Preparation of Ascorbic Acid injection 8. Qulaity control test of (as per IP) marketed tablets and capsules 9. Preparation of Eye drops/ and Eye ointments 10. Preparation of Creams (cold / vanishing cream) 11. Evaluation of Glass containers (as per IP)	L3	4 Hours / Week

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Physical Pharmacy and Pharmaceutical Sciences by Alfred Martin, Lippincott Williams and Wilkins Publishers.
2. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz.
3. Tutorial Pharmacy by Cooper and Gunn, Edited by S. J. Carter.
4. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman.
5. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition.
6. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Sciences (RPS).

Reference Books

1. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition.
2. Theory and Practice of Industrial Pharmacy by Liberman & Lachman.
3. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005.
4. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Marcel Dekkar Inc.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO2	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO3	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2507	PHARMACOLOGY PRACTICAL-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject imparts 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 in addition to emphasis on the basic concepts of bioassay.

Course Objectives

The objective of this course is to

1. Explain and equip students about the mechanism of different drugs on various organ/tissue systems in different diseases.
2. Make student understand about the involvement of various receptor/enzymes/proteins involved in these phenomena.

Course Outcomes

On completion of this course, the 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.

CO4: Appreciate correlation of pharmacology with related medical sciences.

Course content

Modules	Blooms level*	Number of hours
List of experiments: 1. Introduction to <i>in-vitro</i> 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	L1 & L3	4 Hours / Week

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 <i>Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos</i>		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

5. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher.
6. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
7. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
8. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Reference Books

6. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier.
7. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
8. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
9. 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, Lippincott Williams & Wilkins.
10. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO2	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO3	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO4	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2508	PHARMACOGNOSY AND PHYTOCHEMISTRY PRACTICAL-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

Upon the successful completion of this course; the students will have the knowledge about:

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

Course Outcomes

After successful completion of this course, the student will be able to

CO1: Describe various methods for the identification and isolation of phytoconstituents and their properties.

CO2: Demonstrate the use of medicinal plant and its industrial importance

CO3: Illustrate various pharmacognostic parameters of crude drugs.

Modules	Blooms level*	Number of hours
List of experiments: 1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander 2. Exercise involving isolation & detection of active principles a. Caffeine - from tea dust.	L1 & L3	4 Hours / Week

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 phytoconstituents by TLC 6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh		
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**Bloom's Level:*

L1:Knowledge; L2:Comprehension; L3:Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), 1st Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, 1st edition, Birla publications, New Delhi, 2007

Reference Books

1. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
2. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
3. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
4. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
5. The formulation and preparation of cosmetic, fragrances and flavours.
6. Remington's Pharmaceutical sciences.
7. Text Book of Biotechnology by Vyas and Dixit.
8. Text Book of Biotechnology by R.C. Dubey.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA	EE
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Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Sixth Semester

PHA 2601	MEDICINAL CHEMISTRY – III	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Make students learn about the classification, mechanism of action, uses, Structure Activity Relationship of Antibiotics, β -Lactam antibiotics and Aminoglycosides
2. Further impart knowledge of various methods of the synthesis of above mentioned class of drugs.

Course Outcomes

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

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

Course Content

Modules	Blooms level*	Number of hours
MODULE 1: Antibiotics, β-Lactam antibiotics, Aminoglycosides and Tetracyclines Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes. β -Lactam antibiotics: Penicillin, Ce-	L1, L2	10

pholosporins, β - Lactamase inhibitors, Monobactams, Streptomycin, Neomycin, Kanamycin, Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline		
MODULE 2: Antibiotics- Macrolides, Antimalarials, Biguanides 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, Artesunate, Artemether, Atovoquone.	L1, L2	10
MODULE 3: Anti-tubercular Agents, Urinary tract anti-infective agents, Antiviral agents: Synthetic anti tubercular agents: Isoniazid, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid. Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate. Urinary tract anti-infective agents Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin, Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirdine, Ribavirin, Saquinavir, Indinavir, Ritonavir.	L1, L2	10
MODULE 4: Antifungal agents, Anti-protozoal Agents, Anthelmintics, Sulphonamides and Sulfones Amphotericin-B, Nystatin, Natamycin, Griseofulvin, Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole, Ketoconazole, Terconazole, Itraconazole,	L1, L2	8

Fluconazole, Naftifine hydrochloride, Tolnaftate, Anti-protozoal Agents: Metronidazole, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine, Anthelmintics: Diethylcarbamazine citrate, Sulphonamides and Sulfones: Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide, Sulphapyridine, Sulfamethoxazole, Sulphadiazine, Mefenide acetate, Sulfasalazine		
MODULE 5: Introduction to Drug Design and Combinatorial Chemistry: Various approaches used in drug design: Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis, Pharmacophore modeling and docking techniques	L1, L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Wilson and Gisvold's Organic medicinal and Pharmaceutical Chemistry, 12th edition, Lippincott Williams and Wilkins, **2018**, ISBN: 9788184733969, 9788184733969,
2. Foye's Principles of Medicinal Chemistry, 8/E (English, Paperback, Thomas L. Lemke Victoria F. Roche, S. William Zito, **2019**, ISBN: 9789389335798, 9789389335798

Reference Books

3. Burger's Medicinal Chemistry, Vol I to IV, **2003**, John Wiley and Sons Ltd, **ISBN 0-471-27090-3**
4. Martindale's extra pharmacopoeia, English, Paperback, Westcott William Wynn, ISBN: 9780341858188, 0341858188

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--
CO2	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--
CO3	1	1	--	--	--	--	--	--	--	--	--	--	1	1	--	--
CO4	1	1	--	--	--	--	--	--	--	--	--	--	2	1	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2602	PHARMACOLOGY-III	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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, immunopharmacology with emphasis on the principles of toxicology and chronopharmacology.

Course Objectives

The objective of this course is to

1. Provide detailed understanding of respiratory, GIT and infectious diseases.
2. Explain students about the mechanism of different drugs on various organ/tissue systems in these diseases the involvement of various receptor/enzymes/proteins involved in these phenomena.
3. Make student understand about principle and treatment of poisoning.

Course Outcomes

On completion of this course, the 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.

Course content

Modules	Blooms level*	Number of hours
MODULE 1: Pharmacology of drugs acting on Respiratory system: Anti -asthmatic drugs, Drugs used in the management of COPD, Expectorants and antitussives, Nasal decongestants, Respiratory stimulants Pharmacology of drugs acting on the Gastrointestinal Tract: Anti-ulcer agents, Drugs for constipation and diarrhea, Appetite stimulants	L1, L2, L3	10

and suppressants, Digestants and carminatives, Emetics and anti-emetics.		
MODULE 2: Chemotherapy: General principles of chemotherapy, Sulfonamides and cotrimoxazole, Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides	L1, L2, L3	10
MODULE 3: Chemotherapy: Antitubercular agents, Antileprotic agents, Antifungal agents, Antiviral drugs, Anthelmintics, Antimalarial drugs, Antiamoebic agents	L1, L2, L3	10
MODULE 4: Chemotherapy: Urinary tract infections and sexually transmitted diseases, Chemotherapy of malignancy. Immunopharmacology: Immunostimulants, Immunosuppressant, monoclonal antibodies, target drugs to antigen, biosimilars	L1, L2, L3	8
MODULE 5: Principles of toxicology: Definition and basic knowledge of acute, subacute and chronic toxicity, Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity, General principles of treatment of poisoning, Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning. Chronopharmacology: Definition of rhythm and cycles, Biological clock and their significance leading to chronotherapy.	L1, L2, L3	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher.
2. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
3. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
4. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Reference Books

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

12. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
13. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
14. 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, Lippincott Williams & Wilkins.
15. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO2	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--
CO3	1	--	1	--	--	2	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2603	HERBAL DRUG TECHNOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

Upon the successful completion of this course; the students will have the knowledge about:

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

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand the standardization techniques of herbal drug.

CO2. Develop the new herbal formulation on the basis of ayurveda principle as per ayurvedic pharmacopoeia.

CO3. Understand the herbal products regulation in India and global market

Course content

Modules	Blooms level*	Number of hours
Module 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	L1 and L2	6

Biodynamic Agriculture Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.		
Module II: 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.	L1 and L2	5
Module III: 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.	L1 and L2	7
Module IV: 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	L1, L2 and L3	10
Module V: 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	L1 and L2	10

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.		
Module VI: 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.	L1 and L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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

Reference Books

1. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
2. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	Attd	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2604	BIOPHARMACEUTICS AND PHARMACOKINETICS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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 arise therein.

Course Objectives

The objective of this course is to

1. Educate and equip the students with concepts of biopharmaceutics and pharmacokinetics.
2. Provide a theoretical overview and calculation of drug-plasma profile along with its kinetics, distribution, absorption, metabolism, excretion and elimination.
3. Understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

Course Outcomes

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

CO1: Explain principle of various pharmacokinetic parameters of drug molecules.

CO2: Explain various aspects of drug kinetics, distribution, absorption, metabolism, excretion and elimination.

CO3: Explain the applications of biopharmaceutics and pharmacokinetics in pharmaceutical development, design of dose and dosage regimen.

CO4: Explain principle of compartmental modelling.

Course content

Modules	Blooms level*	Number of hours
MODULE 1: Biopharmaceutics Absorption: Mechanisms of drug absorption through GIT, factors influencing drug absorption through 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 tis-	L1, L2	10

sue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding. Clinical significance of protein binding of drugs		
MODULE 2: Elimination, bioavailability and bioequivalence Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	L1, L2	10
MODULE 3: Pharmacokinetics 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) Extravascular administrations. Pharmacokinetics parameters - KE , $t_{1/2}$, V_d , AUC , K_a , Cl_t and CL_R - definitions methods of eliminations, understanding of their significance and application	L1, L2	10
MODULE 4: Multi-compartment models Multi-compartment models: Two compartment open model. I.V. bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.	L1, L2	8
MODULE 5: Nonlinear Pharmacokinetics Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.	L1, L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 International edition.USA
4. Bio pharmaceuticals and Pharmacokinetics-A Treatise, By D. M. Brahmanekar and Sunil B.Jaiswal. Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: By Milo Gibaldi Donald, R. Mercey 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
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company. Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition. Revised and expanded by Robert F Notari Marcel Dekker Inc, New York and Basel, 1987

Reference Books and journals

1. Remington's Pharmaceutical Sciences, By Mack Publishing Company, Pennsylvania.
2. Journal articles.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	--	--	--	--	--	--	--	--	--	--	1	-	--	--
CO2	1	-	--	--	--	--	--	--	--	--	--	--	1	-	--	--
CO3	1	-	--	--	--	--	--	--	--	--	--	--	1	-	--	--
CO4	1	-	--	--	--	--	--	--	--	--	--	--	1	-	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2605	PHARMACEUTICAL BIOTECHNOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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.

Course Objectives

Upon the successful completion of this course; the students will have the knowledge about:

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

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand and recall the historical development in Pharmaceutical biotechnology.

CO2. Describe the basic principle of antigen antibody reaction mechanism related to immunity of human body.

CO3. Employ the knowledge in to genetic and recombination technology and microbial transformation in industrial biotechnology.

Course content

Modules	Blooms level*	Number of hours
Module 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 in-	L1 and L2	10

roduction to Protein Engineering. e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. f) Basic principles of genetic engineering.		
Module 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 products: d) Interferon b) Vaccines-hepatitis- B c) Hormones- Insulin. e) Brief introduction to PCR Types of immunity- humoral immunity, cellular immunity	L1 and L2	10
Module III: 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	L1 and L2	10
Module 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.	L1 and L2	8
Module V: a. Types of mutation/mutants b) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring. c) Large scale production fermenter design and its various controls. d) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,	L1 and L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications

of Recombinant DNA: ASM Press Washington D.C.

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

3. J.W. Goding: Monoclonal Antibodies.

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

Reference Books

1. Zaborsky: Immobilized Enzymes, CRC Press, Degrand, Ohio.

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

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	Attd	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	-	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2606	PHARMACEUTICAL QUALITY ASSUR- ANCE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Practice the cGMP aspects in a pharmaceutical industry.

CO2. Contribute into documentation

CO3. Handle the responsibilities of QA & QC departments

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	10

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration NABL accreditation : Principles and procedures		
Module 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.	L1, L2	10
Module 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	L1, L2	10
Module 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.	L1, L2	08
Module 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	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2607	MEDICINAL CHEMISTRY PRACTICAL – III	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Make students learn about the classification, mechanism of action, uses, Structure Activity Relationship of Antibiotics, β -Lactam antibiotics and Aminoglycosides
2. Further impart knowledge of various methods of the synthesis of above mentioned class of drugs and to perform the synthesis of some of the drugs.

Course Outcomes

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

CO 1. Understand the importance of drug design and different in-silico techniques of drug design.

CO 2. Understand the chemistry of drugs with respect to their biological activity.

CO 3. Know the metabolism, adverse effects and therapeutic value of drugs.

CO 4. Know the importance of SAR of drugs.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I– Preparation of drugs and intermediates 1. Sulphanilamide 2. 7-Hydroxy, 4-methyl coumarin 3. Chlorobutanol 4. Triphenyl, imidazole 5. Tolbutamide 6. Hexamine II-Assay of drugs 1. Isonicotinic acid hydrazide 2. Chloroquine 3. Metronidazole 4. Dapsone 5. Chlorpheniramine maleate 6. Benzyl penicillin III- Preparation of medicinally important compounds or intermediates by Microwave irradiation technique IV- Drawing structures and reactions using chem draw	L3	4 Hours / Week

V- Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2608	PHARMACOLOGY PRACTICAL -III	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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, immunopharmacology with emphasis on the principles of toxicology and chronopharmacology.

Course Objectives

The objective of this course is to

1. Provide detailed understanding of respiratory, GIT and infectious diseases.
2. Explain students about the mechanism of different drugs on various organ/tissue systems in these diseases the involvement of various receptor/enzymes/proteins involved in these phenomena.
3. Make student understand about principle and treatment of poisoning.

Course Outcomes

On completion of this course, the 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.

Course content

Modules	Blooms level*	Number of hours
List of experiments: 1. Dose calculation in pharmacological experiments 2. Antiallergic activity by mast cell stabilization assay 3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model. 4. Study of effect of drugs on gastrointestinal motility	L3 & L4	4 Hours / Week

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) <i>*Experiments are demonstrated by simulated experiments/videos</i>		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher.
2. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
3. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
4. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

Reference Books

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier.
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO2	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--
CO3	1	2	1	--	--	--	--	--	--	--	--	--	1	--	2	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2609	HERBAL DRUG TECHNOLOGY PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

Upon the successful completion of this course; the students will have the knowledge about:

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

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand the standardization techniques of herbal drug.

CO2. Develop the new herbal formulation on the basis of ayurveda principle as per ayurvedic pharmacopoeia.

CO3. Understand the herbal products regulation in India and global market

Course content

Modules	Blooms level*	Number of hours
List of experiments: 1. To perform preliminary phytochemical screening of crude drugs. 2. Determination of the alcohol content of Asava and Arista 3. Evaluation of excipients of natural origin 4. Incorporation of prepared and standardized extract in cosmetic	L3	4 Hours / Week

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		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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

Reference Books

1. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
2. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
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CO1	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2
CO2	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2
CO3	1	2	-	-	-	-	-	2	-	2	-	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

Syllabus – B. Pharm Seventh Semester

PHA2701	INSTRUMENTAL METHODS OF ANALYSIS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course 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.

Course Outcomes

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

CO1: Explain principle of various techniques of analysis including UV spectrometry, fluorimetry, IR, flame photometry, atomic absorption spectroscopy and techniques of chromatography.

CO2: Explain instrumentation and applications of UV spectrometry, fluorimetry, IR, flame photometry, atomic absorption spectroscopy and techniques of chromatography.

CO3: Analyse and apply the correct technique to perform the analysis of known or unknown compounds.

CO4: Apply the relevant analytical technique for purification, isolation and characterisation of pharmaceutical or other samples.

Course content

Modules	Blooms level*	Number of hours
MODULE 1: UV visible spectroscopy and fluorimetry Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Deriva-	L1, L2	10

tion 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.		
MODULE 2: IR spectroscopy, flame photometry, atomic absorption spectroscopy and nepheloturbidometry IR spectroscopy- Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. Instrumentation - Sources of radiation, wavelength selectors and 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.	L1, L2	10
MODULE 3: 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.	L1, L2	10
MODULE 4: Chromatography Gas chromatography- Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications. High performance liquid chromatography (HPLC) - Introduction, theory, instrumentation, advantages and applications.	L1, L2	8
MODULE 5: Chromatography Ion exchange chromatography- Introduction, ion exchange resins, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications. Gel and affinity chromatography- Introduction, instrumentation and applications.	L1, L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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

Reference Books and journals

1. Organic spectroscopy by William Kemp
2. Quantitative Analysis of Drugs by D. C. Garrett
3. Spectrophotometric identification of Organic Compounds by Silverstein
4. Journal articles (e.g., from American Chemical Society and Sciencedirect)

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	1	--	--	--	--	--	--	--	--	--	1	--	1	--
CO2	1	-	1	--	--	--	--	--	--	--	--	--	1	--	1	--
CO3	1	-	1	--	--	--	--	--	--	--	--	--	1	--	1	--
CO4	1	-	1	--	--	--	--	--	--	--	--	--	1	--	1	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2702	INDUSTRIAL PHARMACY-II	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Develop concepts for set up of manufacturing plants and various techniques for scale up of several drug dosage forms and understand various considerations for scale up.
2. Make students understand about regulatory requirements for manufacturing, sale, marketing of drug products.

Course Outcomes

On completion of this course, the 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.

CO4: Understand the approval process and regulatory requirements for drug products.

Course Content

Modules	Blooms level*	Number of hours
MODULE 1: 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.	L1, L2, L3	10
MODULE 2: 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,	L1, L2, L3	10

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		
MODULE 3: 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.	L1, L2, L3	10
MODULE 4: 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.	L1, L2, L3	8
MODULE 5: 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.	L1, L2, L3	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs: A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
2. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Sciences (RPS).
3. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz.
4. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman.

Reference Books

5. Physical Pharmacy and Pharmaceutical Sciences by Alfred Martin, Lippincott Williams and Wilkins Publishers.
6. Tutorial Pharmacy by Cooper and Gunn, Edited by S. J. Carter.
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition.
8. Theory and Practice of Industrial Pharmacy by Liberman & Lachman.
9. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005.
10. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Marcel Dekkar Inc.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1	--	2	--	--	--	--	--	--	1	1	2	2
CO2	1	2	1	1	--	2	--	--	--	--	--	--	1	1	2	2
CO3	1	2	1	1	--	2	--	--	--	--	--	--	1	1	2	2
CO4	1	2	1	1	--	2	--	--	--	--	--	--	1	1	2	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2703	PHARMACY PRACTICE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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.

Course Outcomes

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

- CO1. Contribute into drug distribution methods in a hospital
- CO2. Manage pharmacy stores and inventory control
- CO3. Monitor drug therapy of patient through medication chart review and clinical review
- CO4. Contribute into pharmaceutical care services

Course Content

Modules	Blooms level*	Number of hours
Module I: a) Hospital and it's organization: Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions. b) Hospital pharmacy and its organization: Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. c) Adverse drug reaction: Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management. d) CommModuley 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.	L1, L2	10
Module II: a) Drug distribution system in a hospital: Dispensing of drugs to in-patients, types of drug distribution systems, charging policy and labeling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. b) Hospital formulary: Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. c) Therapeutic drug monitoring: Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. d) Medication adherence: Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient	L1, L2	10

medication adherence. e) Patient medication history interview: Need for the patient medication history interview, medication interview forms. f) CommModuley pharmacy management: Financial, materials, staff, and infrastructure requirements.		
Module III: a) Pharmacy and therapeutic committee: Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation. b) Drug information services: Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information. c) Patient counseling: Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist d) Education and training program in the hospital: Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for commModuley pharmacy, and Role of pharmacist in the interdepartmental communication and commModuley health education. e) Prescribed medication order and communication skills: Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.	L1, L2	10
Module IV: a) Budget preparation and implementation: Budget preparation and implementation b) Clinical Pharmacy: Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. c) Over the counter (OTC) sales: Introduction and sale of over the counter, and Rational use of common over the counter medications.	L1, L2	08

Module V: a) Drug store management and inventory control: Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure b) Investigational use of drugs: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee. c) Interpretation of Clinical Laboratory Tests: Blood chemistry, hematology, and urinalysis	L1, L2	07
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Edition)

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

Journals:

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2704	NOVEL DRUG DELIVERY SYSTEM	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

The method by which a drug is delivered can have a significant effect on its efficacy. Some drugs have an optimum concentration range within which maximum benefit is derived, and concentrations above or below this range can be toxic or produce no therapeutic benefit at all. On the other hand, the very slow progress in the efficacy of the treatment of severe diseases, has suggested a growing need for a multidisciplinary approach to the delivery of therapeutics to targets in tissues. From this, new ideas on controlling the pharmacokinetics, pharmacodynamics, non-specific toxicity, immunogenicity, biorecognition, and efficacy of drugs were generated. These new strategies, often called drug delivery systems (DDS), are based on interdisciplinary approaches that combine polymer science, pharmaceuticals, bioconjugate chemistry, and molecular biology.

Course Objectives

The objective of this course is to:

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

Course Outcomes

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

CO1. To understand the about the Introduction, terminology advantages, disadvantages, selection of drug candidates. Approaches to design-controlled release formulations. Introduction, classification, properties, advantages and application of polymers in formulation.

CO2. To understand the formulation of Microencapsulation, Mucosal Drug Delivery system, Implantable Drug Delivery Systems and their advantage and disadvantage.

CO3. To understand about the formulation of Transdermal Drug Delivery Systems, Gastroretentive drug delivery systems, Nasopulmonary drug delivery system and their applications.

CO4. To understand about targeted drug delivery including concepts, approaches, advantages/disadvantages and introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies with their applications.

CO5. To understand about ocular drug delivery systems, intrauterine drug delivery systems and their advantages/disadvantages.

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1 and L2	10
Module II: Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump	L1 and L2	9
Module III: Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers	L1 and L2	8
Module IV: Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications	L1 and L2	9
Module V: Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts	L1 and L2	9

Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications.		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

2. Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
4. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	-	--	--	--	--	2	--	--	--	1	-	-	2
CO2	1	-	-	-	--	--	--	--	2	--	--	--	1	-	-	2
CO3	1	-	-	-	--	--	--	--	2	--	--	--	1	-	-	2
CO4	1	-	-	-	--	--	--	--	2	--	--	--	1	-	-	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2705	INSTRUMENTAL METHODS OF ANALYSIS PRACTICAL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	4	2
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This course deals with the application of instrumental methods in qualitative and quantitative analysis of drugs.

Course Objectives

The objective of this course is to

1. Impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique.
2. Impart practical knowledge on modern analytical instruments that are used for drug testing.
3. Understand method of sample preparation and sequence of analysis using various analytical techniques.
4. Perceive the significance of appropriate technique for the analysis of the given sample.

Course Outcomes

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

CO1. Perform separation and extraction of samples using various chromatographic procedures including column chromatography and thin-layer chromatography.

CO2. Perform analysis of samples using gas chromatography and high-performance liquid chromatography.

CO3. Perform the assay of the given sample using UV spectrophotometer.

CO4. Describe other important analytical techniques including colorimetry, nepheloturbidometry and fluorimetry.

Course Content

Modules	Blooms level*	Number of hours
List of experiments: I–Experiments of colorimetry	L3	4 Hours / Week

- Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds - Estimation of dextrose by colorimetry - Estimation of sulfanilamide by colorimetry II–Experiments of UV spectroscopy and fluorimetry - Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy. - Assay of paracetamol by UV- Spectrophotometry - Estimation of quinine sulfate by fluorimetry - Study of quenching of fluorescence III– Experiments of flame photometry and nepheloturbidometry -Determination of sodium by flame photometry - Determination of potassium by flame photometry - Determination of chlorides and sulphates by nepheloturbidometry IV–Experiments involving chromatographic procedures - Separation of amino acids by paper chromatography - Separation of sugars by thin layer chromatography - Separation of plant pigments by column chromatography - Demonstration experiment on HPLC - Demonstration experiment on Gas Chromatography		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4-Analysis; L5-Synthesis, L6-Evaluation

Recommended Books (Latest Editions)

Instrumental Methods of Chemical Analysis by B.K Sharma

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination**Examination Scheme:**

	IA				EE	
Components	A	PR	LR	V	PR	V
Weightage (%)	02	05	03	05	25	10

Note: A– Attendance, IA– Internal Assessment, EE– External Exam, PR– Performance, LR– Lab Record V– Viva

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	1	-	--	--	--	--	--	--	--	--	1	2	3	--
CO2	1	1	-	--	--	--	--	--	--	--	--	1	2	3	--
CO3	1	1	-	--	--	--	--	--	--	--	--	1	2	3	--
CO4	1	1	-	--	--	--	--	--	--	--	--	1	2	3	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2706	PRACTICE SCHOOL	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	-	6
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject deals with the practice in any one of the preferred pharmaceutical domains by the student. It will test the knowledge and skills acquired by the student through practice school and shall be evaluated by the subject experts at college level.

Course Objectives

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

Examination Scheme:

Total: 150 marks

Internal Marks : 25

Continuous Mode:

Assignment	Periodic report
10	15

External Marks: 125

Objective(s) of the work done	15 Marks
Learning Outcomes	30 Marks
Presentation of Work	30 Marks
Communication skills	20 Marks
Question and answer skills	30 Marks
Total = 125 Marks	

Syllabus – B. Pharm Eighth Semester

PHA2801	BIostatISTICS AND RESEARCH METHODOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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, analysing the statistical data using Excel.

Course Objectives

Upon completion of the course the student shall be able to

1. Know the operation of M.S. Excel, SPSS, R & MINITAB®, DoE (Design of experiment).
2. Know the various statistical techniques to solve statistical problems
3. Appreciate statistical techniques in solving the problems.

Course Outcomes

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

CO1: Explain and apply various statistical techniques to analyse the significance and outcome of the given sample or data.

CO2: Explain and apply appropriate parametric or non-parametric test on the given data.

CO3: Utilize appropriate test in experimental design of clinical trials.

CO4: Establish and apply relevant tests for optimisation, quality control and process validation.

Course content

Modules	Blooms level*	Number of hours
MODULE 1: Introduction: Statistics, Biostatistics, Frequency distribution, Measures of central tendency and dispersion. Correlation Introduction: Statistics, Biostatistics, Frequency distribution Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples. Measures of dispersion: Dispersion, Range, standard deviation	L1, L2	10

tion, Pharmaceutical problems. Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation Pharmaceuticals examples		
MODULE 2: Regression, Probability and Parametric tests Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression– Pharmaceutical Examples. Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties- problems. Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error- I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples. Parametric test: <i>t</i>-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significance difference.	L1, L2	10
MODULE 3: Non Parametric tests, graphs and designing of methodology 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, Experimental Design Technique, and 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.	L1, L2	10
MODULE 4: Regression modeling and introduction to Practical components of Industrial and Clinical Trials Problems Blocking and confounding system for Two-level factorials Regression modeling: Hypothesis testing in Simple and Multiple regression models. Introduction to Practical components of Industrial and Clinical Trials Problems: Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R-Online Statistical Software's to Industrial and Clinical trial approach.	L1, L2	8
MODULE 5: Design and analysis of experiments	L1, L2	7

Factorial Design: Definition, advantage of factorial design.		
Response Surface methodology: Central composite design, Historical design and optimization techniques		

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.
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

Reference Books and journals

1. Journal articles and other published data.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	1	1	--	--	--	--	--	--	--	--	1	-	1	2
CO2	1	-	1	1	--	--	--	--	--	--	--	--	1	-	1	2
CO3	1	-	1	1	--	--	--	--	--	--	--	--	1	-	1	2
CO4	1	-	1	1	--	--	--	--	--	--	--	--	1	-	1	2

1: strongly related, 2: moderately related and 3: weakly related

PHA2802	SOCIAL AND PREVENTIVE PHARMACY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Solve the health and pharmaceutical problems within the country and worldwide.

CO2. Apply his/her knowledge into current healthcare development.

CO3. Derive alternative ways of solving problems related to health and pharmaceutical issues.

Course Content

Modules	Blooms level*	Number of hours
Module 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 dis-	L1, L2	10

ease, Impact of urbanization on health and disease, Poverty and health Hygiene and health: personal hygiene and health care; avoidable habits		
Module 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.	L1, L2	10
Module III: National health programs, its objectives, functioning and outcome of the following: HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.	L1, L2	10
Module 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	L1, L2	08
Module V: CommModuley services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 Rabin-dra 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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	1	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	1	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	1	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2837	PROJECT WORK	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	0	0	-	6
Pre-requisites/Exposure					
Co-requisites					

Objectives:

The aim of the project work is to provide student with an opportunity to further intellectual and personal development in chosen field by undertaking a significant practical unit of activity, having an educational value at a level commensurate with the award of the degree. The project work can be defined as a scholarly inquiry into a problem or issues, involving a systematic approach to gathering and analysis of information / data, leading to production of a structured report.

The area of the project shall directly relate any one of the elective subject opted by the student in semester VIII. The project shall be carried out in group not exceeding 5 in number. The project report shall be submitted in triplicate (typed & bound copy not less than 25 pages).

THE COMPONENTS OF A PROJECT REPORT

The outcome of Project Work is the Project Report. A project report should have the following components:

- 1) Cover Page:** This should contain the title of the project proposal, to whom it is submitted, for which degree, the name of the author, name of the supervisor, year of submission of the project work, name of the University.
- 2) Acknowledgement:** Various organizations and individuals who might have provided assistance /co-operation during the process of carrying out the study.
- 3) Table of Content:** Page-wise listing of the main contents in the report, i.e., different Chapters and its main Sections along with their page numbers.
- 4) Body of the Report:** The body of the report should have these four logical divisions
 - a. *Introduction:* This will cover the background, rationale/ need / justification, brief review of literature, objectives, methodology (the area of the study, sample, type of study, tools for data collection, and method of analysis), Limitations of the Study, and Chapter Planning.
 - b. *Conceptual Framework / National and International Scenario:* (relating to the topic of the Project).
 - c. *Presentation of Data, Analysis and Findings:* (using the tools and techniques mentioned in the methodology).

d. *Conclusion and Recommendations*: In this section, the concluding observations based on the main findings and suggestions are to be provided.

5) Bibliography or References: This section will include the list of books and articles which have been used in the project work, and in writing a project report.

6) Annexures: Questionnaires (if any), relevant reports, etc.

(The main text of the Project should normally be in the range of 5000 words. However, there may be annexure in addition to the main text)

THE STEPS OF PROJECT WORK

STEP I : Selection of the topic for the project by taking following points into consideration:

- Suitability of the topic.
- Relevance of the topic
- Time available at the disposal.
- Feasibility of data collection within the given time limit.
- Challenges involved in the data collection (time & cost involved in the data collection, possibility of getting responses, etc.)

STEP II : Finalisation of the Topic and preparation of Project Proposal in consultation with the Supervisor.

STEP III : Collection of information and data relating to the topic and analysis of the same.

STEP IV : Writing the report dividing it into suitable chapters, viz.,

Chapter 1: Introduction,

Chapter 2: Conceptual Framework / National & International Scenario,

Chapter 3: Analysis & Findings

Chapter 4: Conclusion and Recommendations.

STEP V : The following documents are to be attached with the Final Project Report.

1) Approval letter from the supervisor (Annexure-IA)

2) Student's declaration (Annexure-IB)

3) Certificate from the Competent Authority of the Organisation / Institution, if the student undertakes the Project Work in any Organisation / Institution.

Annexures, References / Bibliography

Guidelines for Evaluation:

- Each of the students has to undertake a Project individually under the supervision of a teacher and to submit the same following the guidelines stated below.
- Language of Project Report and Viva-Voce Examination may be English. The Project Report must be typed and hard bound.

- Failure to submit the Project Report or failure to appear at the Viva-voce Examination will be treated as —Absentl in the Examination. He /she has to submit the Project Report and appear at the Viva-Voce Examination in the subsequent years (within the time period as per University Rules).
- No marks will be allotted on the Project Report unless a candidate appears at the Viva-Voce Examination. Similarly, no marks will be allotted on Viva-Voce Examination unless a candidate submits his/her Project Report.
- Evaluation of the Project Work to be done jointly by one internal expert and one external expert with equal weightage, i.e., average marks of the internal and external experts will be allotted to the candidate.
- A candidate has to qualify in the Project Work separately, obtaining minimum marks of 80 (Dissertation Book and Presentation taken together).

Examination Scheme: Total-150 marks

Evaluation of Dissertation Book:

Objective(s) of the work done	15 Marks
Methodology adopted	20 Marks
Results and Discussions	20 Marks
Conclusions and Outcomes	20 Marks

Total-75 Marks

Evaluation of Presentation:

Presentation of work	25 Marks
Communication skills	20 Marks
Question and answer skills	30 Marks

Total-75 Marks

PHA 2803	PHARMA MARKETING MANAGE- MENT	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Course Outcomes

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

CO1. Explain different marketing concepts

CO2. Analyze marketing techniques for product decision and product portfolio

CO3. Apply marketing concepts and techniques in the pharmaceutical industry

CO4. Design various pharmaceutical marketing channels.

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1, L2	10
Module II:	L1, L2	10

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.		
Module 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.	L1, L2	10
Module 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.	L1, L2	08
Module V: Pricing: Meaning, importance, objectives, and determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). Emerging concepts in marketing: Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, Indian-Context,Macmilan India, New Delhi.

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

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	1	--	--	1	--	--	--	--	--	--	1	--	--	--
CO2	1	1	--	--	1	--	--	--	--	--	--	1	--	--	--
CO3	1	1	--	--	1	--	--	--	--	--	--	1	--	--	--
CO4	1	1	--	--	1	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2804	PHARMACEUTICAL REGULATORY SCIENCE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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

Course Outcomes

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

CO1. Explain the process of drug discovery and development

CO2. Explain about the various regulatory authorities and agencies and regulatory approval process

CO3. Prepare various documents for Registration of Indian drug product in overseas market

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1, L2	10
Module II: Regulatory Approval Process: Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application	L1, L2	10

(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)		
Module 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.	L1, L2	10
Module 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	L1, L2	08
Module V: Regulatory Concepts: Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended books (Latest edition):

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 Healthcare 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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2805	PHARMACOVIGILANCE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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 paediatrics, 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.

Course Outcomes

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

- CO1. Write different ICH guidelines
- CO2. Write about different Pharmacovigilance methods
- CO3. Document adverse drug reaction of any drug
- CO4. Analyze Pre clinical data

Course Content

Modules	Blooms level*	Number of hours
Module I: Introduction to Pharmacovigilance History and development of Pharmacovigilance Importance of safety monitoring of Medicine WHO international drug monitoring programme Pharmacovigilance Program of India(PvPI) Introduction to adverse drug reactions Definitions and classification of ADRs Detection and reporting Methods in Causality assessment Severity and seriousness assessment Predictability and preventability assessment Management of adverse drug reactions Basic terminologies used in pharmacovigilance Terminologies of adverse medication related events Regulatory terminologies	L1, L2	10
Module II: Drug and disease classification Anatomical, therapeutic and chemical classification of drugs International classification of diseases Daily defined doses International Non proprietary Names for drugs Drug dictionaries and coding in pharmacovigilance WHO adverse reaction terminologies MedDRA and Standardised MedDRA queries WHO drug dictionary Eudravigilance medicinal product dictionary Information resources in pharmacovigilance Basic drug information resources Specialised resources for ADRs Establishing pharmacovigilance programme Establishing in a hospital Establishment & operation of drug safety department in industry Contract Research Organisations (CROs) Establishing a national programme	L1, L2	10
Module III: Vaccine safety surveillance Vaccine Pharmacovigilance Vaccination failure Adverse events following immunization	L1, L2	10

Pharmacovigilance methods Passive surveillance – Spontaneous reports and case series Stimulated reporting Active surveillance – Sentinel sites, drug event monitoring and registries Comparative observational studies – Cross sectional study, case control study and cohort study Targeted clinical investigations Communication in pharmacovigilance Effective communication in Pharmacovigilance Communication in Drug Safety Crisis management Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media		
Module 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	L1, L2	08
Module 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	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest edition):

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 & 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 & Pharmacovigilance: Barton Cobert, Jones & Bartlett Publishers.
7. Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice - Essential Concepts and Skills: G. Parthasarathi, Karin Nyfort Hansen, Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. <http://www.who.int/dynpage.aspx?id=105825&mn1=7347&mn2=7259&mn3=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

Modes of Evaluation: Quiz/Assignment/ Seminar/ Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	2	--	--	2	--	--	1	--	--	--
CO2	1	--	1	--	--	2	--	--	2	--	--	1	--	--	--
CO3	1	--	1	--	--	2	--	--	2	--	--	1	--	--	--
CO4	1	--	1	--	--	2	--	--	2	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2806	QUALITY CONTROL AND STANDARDIZATION OF HERBALS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is 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

Course Outcomes

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

- CO1. Perform quality control of herbal drugs
- CO2. Perform various tests for herbal drugs
- CO3. Write about regulatory approval process
- CO4. Perform suitable chromatographic techniques for standardization of herbal products

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	10
Module 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	L1, L2	10

WHO Guidelines on GACP for Medicinal Plants.		
Module III: EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	L1, L2	10
Module 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.	L1, L2	08
Module 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	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books: (Latest Editions

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I, Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.

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

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

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO4	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2807	COMPUTER AIDED DRUG DESIGN	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

1. Understand design and discovery of lead molecules
2. Understand the role of drug design in drug discovery process
3. Understand the concept of QSAR and docking
4. Understand various strategies to develop new drug like molecules
5. Understand the design of new drug molecules using molecular modeling software

Course Outcomes

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

CO1. Write the steps for design and discovery of lead molecules

CO2. Explain role of drug design in drug discovery process

CO3. Write about various screening techniques for Molecular Modeling.

Course Content

Modules	Blooms level*	Number of hours
Module 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	L1, L2	10
Module II: Quantitative Structure Activity Relationship (QSAR): SAR versus	L1, L2	10

QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.		
Module 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. <i>De novo</i> drug design.	L1, L2	10
Module IV: Informatics & Methods in drug design: Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	L1, L2	08
Module V: Molecular Modeling: Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvold'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.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	1	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2808	CELL AND MOLECULAR BIOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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.

Course Objectives

The objective of this course is to

1. Summarize cell and molecular biology history
2. Summarize cellular functioning and composition
3. Describe the chemical foundations of cell biology
4. Summarize the DNA properties of cell biology
5. Describe protein structure and function
6. Describe cellular membrane structure and function
7. Describe basic molecular genetics mechanism.
8. Summarize the Cell Cycle

Course Outcomes

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

CO1. Write about cellular functioning and composition

CO2. Explain protein structure and function

CO3. Differentiate between Mitosis and Meiosis process.

Course Content

Modules	Blooms level*	Number of hours
Module I: a) Cell and Molecular Biology: Definitions theory and basics and Applications.	L1, L2	10

b) Cell and Molecular Biology: History and Summation. c) Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)		
Module II: a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	L1, L2	10
Module 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,	L1, L2	10
Module IV: a) Science of Genetics b) Transgenics and Genomic Analysis c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	L1, L2	08
Module V: a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways	L1, L2	07

e) Protein-Kinases: Functioning		
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**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (latest edition):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. 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 Recombinant DNA: ASM Press Washington D.C.
13. RA Goldshy et. al.,: Kuby Immunology.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2809	COSMETIC SCIENCE	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This course is designed to impart the fundamental knowledge on the cosmetic and cosmeceutical products.

Course Objectives

The objective of this course is to

1. To impart knowledge about the basic concepts of cosmetic and cosmeceutical products
2. Understand principles of formulation and building blocks of Hair care products

Course Outcomes

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

CO1. Classify various cosmetic and cosmeceutical products

CO2. Write about Principles of different cosmetic formulation

CO3. Explain about the role of herbs in cosmetics

Course Content

Modules	Blooms level*	Number of hours
Module 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, rheologymodifiers, 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.	L1, L2	10
Module II: Principles of formulation and building blocks of skin care products: Face wash, Moisturizing cream, Cold Cream, Vanishing cream	L1, L2	10

and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals. Antiperspirants & 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-phenylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.		
Module III: Sun protection, Classification of Sunscreens and SPF. Role of herbs in cosmetics: Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove Analytical cosmetics: BIS specification and analytical methods for shampoo, skin cream and toothpaste.	L1, L2	10
Module 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 benefits.	L1, L2	08
Module 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	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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 cosmetology by Sanju Nanda & Roop K. Khar, Tata Publishers.

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO2	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--
CO3	1	--	1	--	--	--	--	--	--	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA 2810	EXPERIMENTAL PHARMACOLOGY	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

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

Course Objectives

The objective of this course is to

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

Course Outcomes

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

CO1. Write CPCSEA and OECD guidelines

CO2. Select Preclinical screening models for for ANS, CNS and CVS activities

CO3. Analyze and interpret Pre-clinical data.

Course Content

Modules	Blooms level*	Number of hours
Module 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.	L1, L2	08
Module II: Preclinical screening models	L1, L2	10

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		
Module III: Preclinical Screening Models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics	L1, L2	10
Module IV: Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants. Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	L1, L2	10
Module V: Research methodology and Bio-statistics: Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	L1, L2	07

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Recommended Books (latest edition):

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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ATTD: Attendance EE: End Semester Examination

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3	PSO4
CO1	1	--	1	1	--	--	2	--	2	--	--	1	--	--	--
CO2	1	--	1	1	--	--	2	--	2	--	--	1	--	--	--
CO3	1	--	1	1	--	--	2	--	2	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

PHA2811	ADVANCED INSTRUMENTATION TECHNIQUES	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Course Objectives

Upon completion of the course the student shall be able to

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

Course Outcomes

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

CO1: Explain principle of various techniques of analysis including NMR, Mass spectrometry, IR, UV spectrometry, X-ray, atomic absorption spectroscopy and techniques of chromatography along with radio-assays.

CO2: Explain instrumentation and applications of NMR, Mass spectrometry, IR, UV spectrometry, X-ray, atomic absorption spectroscopy and techniques of chromatography along with radio-assays.

CO3: Analyse and apply the correct technique to perform the analysis of known or unknown compounds.

CO4: Apply the relevant analytical technique for purification, isolation and characterisation of pharmaceutical or other samples.

Course content

Modules	Blooms level*	Number of hours
MODULE 1: NuclearMagnetic Resonance and Mass spectroscopy	L1,	10

NuclearMagnetic Resonance spectroscopy Principles of H-NMR and C-NMR, chemical shift, factors affecting chemicalshift, coupling constant, Spin - spin coupling, relaxation, instrumentation andapplications. Mass Spectrometry- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time offlight and Quadrupole, instrumentation, applications.	L2,L3	
MODULE 2: Thermogravimetric analysis and X-ray Thermal Methods of Analysis: Principles, instrumentation and applicationsof 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 diffraction,powderdiffraction, structural elucidation and applications.	L1, L2	10
MODULE 3:Calibration 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	L1, L2	10
MODULE 4: Radioimmunoassay and extraction techniques 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 solidphaseextraction and liquid-liquid extraction	L1, L2	8
MODULE 5: Hyphenated techniques Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.	L1, L2	7

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text 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

Reference Books and journals

1. Organic spectroscopy by William Kemp
2. Quantitative Analysis of Drugs by D. C. Garrett
3. Spectrophotometric identification of Organic Compounds by Silverstein
4. Journal articles (e.g., from American Chemical Society and Sciencedirect)

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	A	CT	S/V/Q	HA	EE
Weightage (%)	4	15	3	3	75

CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, EE: End Semester Examination; Att: Attendance

CO, PO and PSO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	-	-	1	--	--	--	--	--	--	--	--	1	-	--	1
CO2	1	-	-	1	--	--	--	--	--	--	--	--	1	-	--	1
CO3	1	-	-	1	--	--	--	--	--	--	--	--	1	-	--	1
CO4	1	-	-	1	--	--	--	--	--	--	--	--	1	-	--	1

1: strongly related, 2: moderately related and 3: weakly related

PHA 2812	DIETARY SUPPLEMENTS AND NUTRACEUTICALS	L	T	P	C
Version 1.0	Date of Approval: 8 th December, 2017	3	1	0	4
Pre-requisites/Exposure					
Co-requisites					

Catalog Description

This subject covers foundational topics that are important for understanding the need and requirements of dietary supplements among different groups in the population. This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements.

Course Objectives

The objective of this course is 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.

Course Outcomes

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

- CO1. Explain the need of supplements by the different group of people to maintain healthy life
- CO2. Write about the components in dietary supplements
- CO3. Evaluate regulatory and commercial aspects of dietary supplements.

Course Content

Modules	Blooms level*	Number of hours
Module 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 nutraceuti-	L1, L2	07

cals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds		
Module 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: Resveratrol d) Flavonoids- Rutin, Naringin, Quercetin, Anthocyanidins, catechins, Flavones e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum f) Phyto estrogens : Isoflavones, daidzein, Geobustan, 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.	L1, L2	15
Module 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.	L1, L2	07
Module 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.	L1, L2	10
Module 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.	L1, L2	06

**Bloom's Level:*

L1-Knowledge; L2-Comprehension; L3-Application; L4:Analysis; L5:Synthesis, L6:Evaluation

Text Books

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and nutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPublication.
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

Modes of Evaluation: Quiz/Assignment/ Seminar/Written Examination

Examination Scheme:

Components	CT	HA	S/V/Q	ATTD	EE
Weightage (%)	15	3	3	4	75

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CO, PO and PSO mapping

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CO1	1	--	2	--	--	--	--	--	2	--	--	1	--	--	--
CO2	1	--	2	--	--	--	--	--	2	--	--	1	--	--	--
CO3	1	--	2	--	--	--	--	--	2	--	--	1	--	--	--

1: strongly related, 2: moderately related and 3: weakly related

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