Outcome-based education (OBE) Curriculum
of
Bachelor of Pharmacy (B. Pharm)

Academic Session: 2022-2023 & Consecutive Years

Department of Pharmacy
Faculty of Science
Comilla University
Cumilla-3506, Bangladesh

Department of Pharmacy

Chairman and Faculty Members

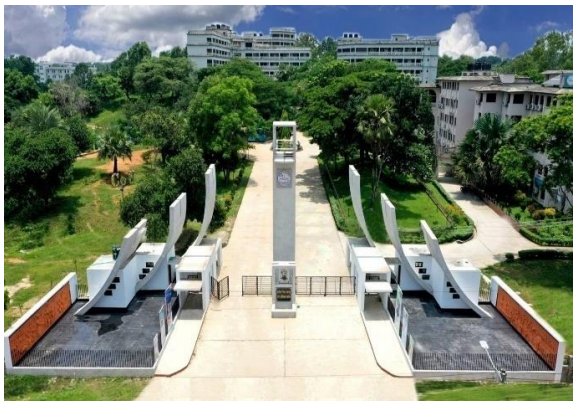
	**Dr. Pradip Debnath** Associate Professor and Chairman Phone: +880-2334411122-24, Ext. 394 **Email:** pradipdebnath@cou.ac.bd; phr.pradip.cou@gmail.com **Research Interest:** Natural Products, Metabolites Studies, Ethnopharmacological Studies
	**Md. Anamul Haque**(on Study Leave) Assistant Professor Email: pharmaripon@gmail.com **Research Interest:** Phytochemistry Cancer Alzheimer disease Nanotechnology Diabetes Antimicrobial study
	**Sayed Koushik Ahamed** (on Study Leave) Assistant Professor **Email:** kousikahmad88@gmail.com **Research Interest:** Neuropharmacology, Neurotransmitter, Psychotropic drugs, Neuroplasticity, Neuromodulation, Neuropharmacokinetics, Neurodegenerative diseases, Psychoactive substances
	**Somaia Haque Chadni**(on Study Leave) Assistant Professor Email: somaiahaquechadni@yahoo.com **Research Interest:**
	**Dr. Jannatul Fardous** Assistant Professor Email: fardousj11@cou.ac.bd **Research Interest:** Drug delivery system, Nanomedicine, Pharmaceutics.
	**Mantasha Tabassum** (on Study Leave) Assistant Professor **Email:** mantu.shonkho@gmail.com **Research Interest:**

	**Rafeza Khatun** Assistant Professor Email: rafeza.ru@gmail.com **Research Interest:** Isolation, purification and characterization of different pharmacological active (antioxidant, antibacterial, anticancer, anti-inflammatory, and anti-diabetic, etc.) natural products.
	**Joy Chandra Rajbangshi** Assistant Professor **Email:** joyraj@cou.ac.bd **Research interest:** Method Development & Validation Formulation & Drug Delivery System
	**Halima Akter** Assistant Professor **Email:** mitumissouri07@gmail.com **Research interest:**
	**Mst. Mahfuza Rahman**(on Study Leave) Assistant Professor **Email:** mahfuzarahman49@gmail.com **Research interest:**
	**Sadia Jahan**(on Study Leave) Assistant Professor **Email:** sadiajahan@cou.ac.bd **Research interest:**
	**Bidduth Kumar Sarkar** Lecturer **Email:** kumarbidduth@cou.ac.bd **Research Interest:** Pharmacology, Pharmaceutical Analysis, Molecular Docking, Toxicology, Phytochemistry and Phytomedicine
	**Md. Kamrul Hasan** Lecturer **Email:** kh.shikhon@cou.ac.bd **Research Interest:** Phytochemistry, Neuropharmacology, Molecular biology and Gene Targeting, Applied Microbiology

Outcome-based education (OBE) Curriculum

Part A: Introduction

Comilla University at a Glance



Comilla University is a public university located in Kotbari, Comilla, Bangladesh. It was established in 2006, and it is the 26th public university in Bangladesh. The university was founded with the goal of providing higher education opportunities to students all over the Bangladesh. The university has a beautiful and spacious campus covering an area of 250 acres. It is situated in a serene environment, surrounded by lush green trees, and is an ideal place for learning. The campus is equipped with all the necessary facilities and infrastructure required for students to excel in their academic pursuits.Comilla University offers undergraduate and graduate programs in various fields, including Arts, Science, Business Administration, Social Science, Engineering and Law. The university has a distinguished faculty, many of whom have earned their Ph.D. degrees from renowned universities around the world. The faculty members are committed to providing quality education to their students and have a strong focus on research. The university has a modern library with a vast collection of books, journals, and research papers.The library is a valuable resource for students and researchers who can access the latest information in their respective fields. The university also has well-equipped laboratories and computer facilities that cater to the needs of students and researchers. Apart from academic programs, Comilla University offers various extracurricular activities for students to engage in. The university has several clubs and organizations, including cultural, sports, and debate clubs. These clubs help students develop their leadership skills, socialize with their peers, and explore their talents outside the classroom. Comilla University has a vibrant and diverse student community, with students from different regions of Bangladesh and other countries. The university provides a welcoming and inclusive environment for all students, regardless of their background or beliefs.

Vision of the University

Comilla University is committed to produce graduates who are distinctively capable to advance growth and welfare through innovative solutions.

Mission of the University

To meet its vision, Comilla University sets its missions to –

1. To educate a wide variety of students through effective teaching-learning to achieve academic excellence
2. To create an ambience for creative and innovative academic exercise through high quality research.
3. To undertake actions regarding collaboration which entails opportunities for long-term interaction with academia and industry for producing competent graduate at workplace
4. To develop human potential to its fullest extent so that intellectually capable and socially responsible leaders can emerge in a range of profession. (Draft Final)

Graduate Attributes:

Comilla University is committed to lead through providing effective teaching, research and culturally enriched educational experience that will transform the lives of its students. Aspiration of the university is to produce graduate through developing knowledge, skill and attitudes to equip them to promote growth and welfare of the rapidly changing world.

In addition, to their subject specific expertise (Mastery of Subject Knowledge) the university graduates will have the following attributes:

- Critical thinking, creativity and innovation
- Communication-Language Proficiency and &Digital Literacy
- Professionalism and Ethical
- Entrepreneurial and Leadership
- Community Engagement and Social responsibility-Cross cultural Communication
- Lifelong learning

Description of the Department of Pharmacy

The Department of Pharmacy was established in 2013. A five (05) years Program (Bachelor in Pharmacy, B. Pharm) and one (01) year Master's Program (M. Pharm) are running in the department. A four (04) years B. Pharm program will be run from the academic session 2022-2023. Since the past pharmacists have played a significant role in public health by discovering and developing numerous therapeutic and life-saving drugs. In the present era, the demand for pharmaceutical products has expanded sharply to manage numerous diseases. Pharmacists are the experts in drugs or medicines. To meet the demand for efficient pharmacists and to improve the health care system, the department of pharmacy, Comilla University is trying to do its best in education and research.

Our course curriculum is designed in such a way that after graduation students will be able to provide best services to society through quality drug manufacturing and by providing patient care through the safe and effective use of medicines either in hospital or community pharmacy as well as in emergent drug innovation research. An optimum balance between theory and practical knowledge is maintained in the overall structure of the curriculum. Currently, the department has 13 efficient and qualified faculty members who supervising students along with the academic activities. We have laboratory facilities for advanced research in Natural Product Chemistry, Pharmacology, Pharmaceutical Microbiology, and Pharmaceutical Technology. Also, the development of more laboratories is progressing.

After graduation from the Department of Pharmacy, a graduate can contribute to any challenging research collaboration by participating with the research groups at home and the world-wide renowned institutes or universities. Alumni of this department are currently working in several pharmaceutical industries in Bangladesh. The faculty members, staffs, and students of the department are working hard collaborate to bring this achievement successfully. The Department of Pharmacy, Comilla University is playing a significant role in creating a way of success that will make skillful human resources for the enrichment of the health care system and sustainable development of the country.

Vision of the Department of Pharmacy:

The vision of the program is to lead the way towards effective global health care through innovative pharmacy education, research and practice.

Mission of the Department of Pharmacy:

The Department of Pharmacy missions is to improve standard of lives locally and globally by educating students who will conduct contemporary research, promote quality of drugs, innovate modern techniques for production of standard drugs and to lead professional service for human being.

Description of the Bachelor of Pharmacy (B. Pharm)

The duration of the Bachelor Degree Program in Pharmacy shall be four academic years divided into eight semesters. Each academic year is divided into two semesters to be called as 1st semester and 2nd semester. An academic semester is comprised of six months. For achieving Degree of Bachelor of Pharmacy (B. Pharm), a student requires to earn a total of 164 credit points successfully with a minimum CGPA of 2.25; and complete the program within six academic years from her/his 1st admission to the program. A student who secures a CGPA below 2.25 but not less than 2.00 will be eligible for a B. Pharm Degree.

Vision of Bachelor of Pharmacy (B. Pharm)

The vision of the Pharmacy is to become a globally functioning academic institution that advances the science of pharmaceuticals via consulting, education, expertise in research, and operational competence.

Mission of Bachelor of Pharmacy (B. Pharm)

M1:	The essence of Department of Pharmacy is to constantly strive to provide an in-depth knowledge to its students so that they add value to the existing treasures of drug formulation and evaluation, pharmacy practice, drug discovery, drug design and development concepts.
M2:	Promote lateral thinking and a spirit of enquiry among our students so that they look from a different angle through a creative approach by which they are able to provide simple solutions to complex problems in pharmaceutical sciences.
M3:	We owe to deliver through our teaching learning process the richness of multidisciplinary knowledge of drug manufacturing, distribution and rational uses in a way where ethics and social commitments will be the corner stone for our students.

Program Educational Objectives (PEO'S)

PEO1:	To provide graduates with theoretical and practical knowledge to cater in various areas including pharmaceutical industry, hospital pharmacy, community pharmacy, regulatory affairs, academia and research.
PEO2:	To produce skilled graduates by providing them appropriate training in all aspects required to meet the need of pharmacy profession.
PEO3:	To equip students with interdisciplinary knowledge for developing competence in solving complex problems in the field of pharmaceutical science.
PEO4:	To offer an academic atmosphere that enables the graduates to acquire behavioral, moral and ethical attitudes required for sound professional practice.
PEO5:	To encourage graduates in life-long self-learning process for developing the ability to serve the society with greater benefits.

Mapping of PEOs and Mission of Bachelor of Pharmacy (B. Pharm)

PEOs / **Missions**	PEO1	PEO2	PEO3	PEO5	PEO5
M1	3	3	2	2	2
M2	2	3	3	3	3
M3	3	2	1	2	2
Correlation: 1-Low; 2- Significance; 3-High					

Program Learning Outcomes (PLO'S)

At the end of the program, students will be able to

PLO1	**Fundamental Knowledge:** Assimilate theoretical along with practical knowledge of pharmaceutical sciences.
PLO2	**Technical Expertise:** Apply technical knowledge in manufacturing and quality control of drug products.
PLO3	**Interpersonal communication Skills:** Communicate with patients, health care professionals and other stakeholders to deliver their acquired knowledge effectively.
PLO4	**Leadership Skills and team work:** Acquire expertise in leadership through curricular and co-curricular activities to lead and contribute for the achievement of organizational goals.
PLO5	**Research and innovations:** Perform research in different field of pharmacy and keep connected with contemporary research.
PLO6	**Patient Care:** Develop a foundational set of skills and abilities to provide consistent and comprehensive patient care.

PLO7	**Lifelong Learning Skills:** Exploit soft skills complementing hard skills to cope up with the changing world.
PLO8	**Entrepreneurship**: Apply skills for designing, launching and running a new ideas and initiatives to promote better health care for the community.
PLO9	**Professionalism and ethics:** Practice pharmacists' professionalism and ethics.
PLO10	**Society and pharmacists:** Develop sense of responsibilities of pharmacist to the society and nation.

Mapping between PEOs and PLOs of Pharmacy program

PLOs / PEOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
PEO1	3	3	2	1	2	2	1	2
PEO2	2	3	3	2	2	2	1	1
PEO3	2	2	3	2	2	3	2	2

(Level of correlation: 3-High, 2-Medium, 1-Low)

Graduates Profile

Scholars: Our graduates are expected to have a broad knowledge-base and disciplinary expertise.

Problem Solvers: With an adequate knowledge of disciplinary expertise and problem domain our graduates will be in a position to formalize any problem and solve that in a methodical way.

Innovators: We want our graduates to be focused on future-proof solution. They will be critical thinkers, creative designers and efficient makers. They are capable of developing unique and sustainable solutions to the real-world problems.

Leaders: Graduates of our department will take personal responsibility and seek opportunities to work with others to advance thinking and achievement in all spheres of their lives. They are confident, inclusive, inspiring and influential.

Global Citizens: Our graduates are locally produced but globally in demand. They are aware of global issues and act with integrity, sensitivity and fluency across cultures and perspectives, and are committed to the betterment of the society as a whole.

Part B – Structure

Structure of the Curriculum

Year & Semester	Course Code	Course Title	Credit Hrs	Marks		
				CIE	SEE	Total
First Year First Semester	PHARM 1101	Introduction to Pharmacy	2	20	30	50
	PHARM 1102	Pharmacognosy and Phytochemistry-I	3	40	60	100
	PHARM 1103	Pharmaceutical Inorganic Chemistry-I	3	40	60	100
	PHARM 1104	Pharmaceutical Organic Chemistry-I	3	40	60	100
	PHARM 1105	Physical Pharmacy-I	3	40	60	100
	PHARM 1106	Computer Applications in Pharmacy	2	20	30	50
	PHARM 1107	Pharmacognosy and Phytochemistry-I Lab	1	20	30	50
		Total	**17**			**550**
First Year Second Semester	PHARM 1201	Pharmaceutics-I	3	40	60	100
	PHARM 1202	Pharmacognosy and Phytochemistry-II	3	40	60	100
	PHARM 1203	Pharmaceutical Microbiology	3	40	60	100
	PHARM 1204	Physiology and Anatomy-I	3	40	60	100
	PHARM 1205	Pharmaceutics-I-Lab	2	40	60	100
	PHARM 1206	Pharmaceutical Microbiology-Lab	2	40	60	100
	PHARM 1207	Pharmacognosy and Phytochemistry-II Lab	1	20	30	50
	PHARM 1208	Viva voce-I	1			50
		Total	**18**			**700**
Second Year First Semester	PHARM 2101	Clinical Pathology	3	40	60	100
	PHARM 2102	Pharmacology-I	3	40	60	100
	PHARM 2103	Pharmaceutical Inorganic Chemistry-II	3	40	60	100
	PHARM 2104	Pharmaceutical Organic Chemistry-II	3	40	60	100
	PHARM 2105	Biochemistry and Molecular Biology	3	40	60	100
	PHARM 2106	Food and Nutraceuticals	2	20	30	50
	PHARM 2107	Pharmacology-I Lab	1	20	30	50

	PHARM 2108	Pharmaceutical Inorganic Chemistry- Lab	2	40	60	50
	PHARM 2109	Pharmaceutical Organic Chemistry-Lab	2	40	60	100
		Total	**22**			**750**
Second Year Second Semester	PHARM 2201	Pharmaceutical Analysis-I	3	40	60	100
	PHARM 2202	Physical Pharmacy-II	3	40	60	100
	PHARM 2203	Physiology and anatomy-II	3	40	60	100
	PHARM 2204	Hospital and Community Pharmacy	3	40	60	100
	PHARM 2205	Biostatitics	2	20	30	50
	PHARM 2206	Biochemistry and Molecular Biology-Lab	2	40	60	100
	PHARM 2207	Physiology and Anatomy-Lab	2	40	60	100
	PHARM 2208	Physical Pharmacy-Lab	2	40	60	100
	PHARM 2209	Viva voce-II	1			50
		Total	**21**			**800**
Third Year First Semester	PHARM 3101	Pharmaceutical Analysis-II	3	40	60	100
	PHARM 3102	Pharmacology-II	3	40	60	100
	PHARM 3103	Medicinal Chemistry-I	3	40	60	100
	PHARM 3104	Biopharmaceutics-I	3	40	60	100
	PHARM 3105	Pharmaceutical Biotechnology	3	40	60	100
	PHARM 3106	Pharmaceutical Analysis-I-Lab	2	40	60	100
	PHARM 3107	Pharmacology-II-Lab	2	40	60	100
	PHARM 3108	Medicinal Chemistry-I-Lab	2	40	60	100
		Total	**21**			**800**
Third Year Second Semester	PHARM 3201	Pharmaceutics-II	3	40	60	100
	PHARM 3202	Pharmaceutical Engineering	3	40	60	100
	PHARM 3203	Biopharmaceutics -II	3	40	60	100
	PHARM 3204	Pharmaceutical Marketing and Management	3	40	60	100
	PHARM 3205	Pharmaceutical Regulatory Affairs	3	40	60	100
	PHARM 3206	Pharmaceutics-II-Lab	2	40	60	100
	PHARM 3207	Biopharmaceutics-Lab	2	40	60	100
	PHARM 3208	Viva voce-III	1			50
		Total	**20**			**750**
	PHARM 4101	Pharmaceutical Analysis-III	3	40	60	100

Fourth Year First Semester	PHARM 4102	Drug and Disease Management	3	40	60	100
	PHARM 4103	Medicinal Chemistry-II	3	40	60	100
	PHARM 4104	Bioinformatics	2	20	30	50
	PHARM 4105	Cosmetology	3	40	60	100
	PHARM 4106	Pharmaceutical Analysis-II-Lab	2	40	60	100
	PHARM 4107	Medicinal Chemistry-II-Lab	2	40	60	100
	PHARM 4108	Cosmetology-Lab	2	40	60	100
		Total	**20**			**750**
Fourth Year Second Semester	PHARM 4201	Pharmceutics-III	3	40	60	100
	PHARM 4202	Pharmacology-III	3	40	60	100
	PHARM 4203	Medicinal Chemistry-III	3	40	60	100
	PHARM 4204	Pharmaceutics-III-Lab	2	40	60	100
	PHARM 4205	Pharmacology-III-Lab	2	40	60	100
	PHARM 4206	Research Project	3			100
	PHARM 4207	In-plant Training	2			50
	PHARM 4208	Hospital Internship	2			50
	PHARM 4209	Viva voce-IV	1			50
		Total	**21**			**750**
		Grand Total	**160**			**5850**

Mapping Courses with PLOs

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
PHARM 1101	3	1	3	2	2	1	2	2	1	
PHARM 1102	2									
PHARM 1103	3	2	3	3						
PHARM 1104	3	2								
PHARM 1105	3	3	3		2	1	3	3	1	
PHARM 1106	2	2								
PHARM 1107	3	3			3					
PHARM 1201	3	2			2	2	2			
PHARM 1202	3				1					
PHARM 1203	2									
PHARM 1204	2				2	2				
PHARM 1205	2	1			2		1			
PHARM 1206	2									
PHARM 1207	3	3	3		2	2	1	3	3	3
PHARM 1208	3								2	
PHARM 2101	3	2			2	2		1		
PHARM 2102	3	2			1					
PHARM 2103	3	2			2			1		
PHARM 2104	3	3								
PHARM 2105	2	2			2	1				

PHARM 2106	2	2			2	1				
PHARM 2107	3	2			3					
PHARM 2108	3	2			2			1		
PHARM 2109	2	3	3	1		3		3		
PHARM 2201	2	2			2					
PHARM 2202	3	3	3	2	2	1	3	3	1	
PHARM 2203	2	3			2	2	2			1
PHARM 2204	3	2	2	1		3		1	1	2
PHARM 2205	2	2			2					
PHARM 2206	1	3			2		1			
PHARM 2207	2									
PHARM 2208	3	2								
PHARM 2209	3								2	
PHARM 3101	2	1			1					
PHARM 3102	3	2			2	3				
PHARM 3103	2	1			1		1			
PHARM 3104	3	2			1					
PHARM 3105	2	3			2					
PHARM 3106	2	2								
PHARM 3107	3	2			3					
PHARM 3108	2	2			2					

PHARM 3201	2	2			3	3	1			
PHARM 3202	3	3			2					
PHARM 3203	3	2				2	2			
PHARM 3204	2		2	2			3	3	1	
PHARM 3205	3	3	3	3	2	1	3	3	1	
PHARM 3206	2	3			2		1			
PHARM 3207	3	3		1	2					
PHARM 3208	3								2	
PHARM 4101	2	1			1					
PHARM 4102	3	3	3	2	2	1	3	3	1	
PHARM 4103	2				1					
PHARM 4104	3	2			2			3		
PHARM 4105	3	3				2		1		2
PHARM 4106	2	2			2					
PHARM 4107	2	3			2					
PHARM 4108	3	3			1	2				
PHARM 4201	2	3			2	2				
PHARM 4202	3	2			2	3				
PHARM 4203	2	3			2		2	1		
PHARM 4204	2	3			2		1			
PHARM 4205	3	3			3	3				

PHARM 4206	3	2			3					
PHARM 4207	3	3	1		3				1	
PHARM 4208	2	2	1		3	3			1	
PHARM 4209	3								2	

PART C
Detailed Curriculum

Course Code: PHARM 1101 Course Title: Introduction to Pharmacy
Marks: 50 Credits: 02

Rationale: Understanding the historical background of pharmacy profession and professional roles of pharmacists and their contribution to the promotion of good health and the prevention of disease.

Course Objectives

- To provide knowledge about historical background of pharmacy profession
- To impart idea about professional roles of pharmacists and their contribution to the promotion of good health and the prevention of disease.

Course Learning Outcomes: at the end of the Course, the Student will be able to-

CLO1	To understand the area and scope of a pharmacist
CLO2	Perceive the history behind the modern healthcare development.
CLO3	Recognize fundamental characteristics of the pharmacy profession including professional and ethical dimensions.
CLO4	Recognize the social responsibilities for a pharmacist to improve the healthcare system.
CLO5	Peculate the basic knowledge about pharmaceutical dosage forms and other system of medicine such as ayurvedic, unani, herbal and homeopathic systems of medicine.
CLO6	To know the drugs and their different forms and uses
CLO7	To know the resources, ethics and professionalism of pharmacy and pharmaceutical sciences

Mapping of Course Outcomes to Program Outcomes-

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	3		3	2	2	1	2	2	
CLO2	3				1				
CLO3	2	1	3				2		
CLO4	1								
CLO5	3		3	3	3	1	2		1

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**History and Evaluation of Pharmacy:** Ancient ages, middle ages, modern ages, development of pharmacy in International and Bangladesh, important pharmacy dates.	5	CLO2
02	**Pharmacy Education:** Definition of pharmacy, specialty of pharmacy education, brief introduction of the courses taught in a pharmacy program, pharmacy education in Bangladesh and other countries.	2	CLO1
03	**Pharmacy Occupation and Profession:** Difference between occupation and profession, pharmacy as a profession, definition and characteristics of pharmacy profession, social recognition and status of pharmacy profession, scopes and opportunities for pharmacists, career development in pharmacy – International and Bangladesh perspective, concept of model pharmacy in Bangladesh.Oath of a pharmacist, professional pharmacy organizations in Bangladesh and abroad, local and foreign drug regulatory bodies.	5	CLO3, CLO4
04	**Drugs and Medicines:** Definition and difference between drug and medicine, sources of drugs, classification of drugs on the basis of actions, target organs, chemical, generic and brand names, different types of dosage forms, Different system of medicine, Who and essential drug concept.	5	CLO5, CLO6
05	**Drug Standards:** Different pharmacopoeias and formularies (USP, BP, NF, BNF, BDNF etc.), pharmaceutical codex, index official, non-official, unofficial and INN drugs (new drugs), monographs of drugs, drug regulation and control.	5	CLO7
06	**Pharmacy Information Resources:** Books, reference and test books, journals, software etc, pharmacy information in the internet, pharmacy journals – home and abroad, study of scientific papers. Referencing system.	4	CLO7

Text Book:

1. R. Hendrickson et. Al.(ed) Remington: The Science and Practice of Pharmacy

Reference books:

1. L. Shargel and Larry N.Swanson: Comprehensive Pharmacy Review
2. A I Wertheimer and M C Smith: Pharmacy practice: Social and behavioral aspects
3. Dr. Md. Shah Amran : Introduction to Pharmacy
4. Dr. Md. Shah Amran : Pharmacy, Pharmaceutical sector and Healthcare

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Pharmacy Education	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2	History and Evaluation of Pharmacy	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3, CLO4	Pharmacy Occupation and Profession	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO5, CLO6	Drugs and Medicines	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO7	Drug Standards, Pharmacy Information Resources	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks):

Bloom's Category Marks (out of 20)	Tests (10)	Assignments (05)	Quizzes/ Presentation (2.5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	4		0.5	
Understand	2.5	1.5	1	
Apply	1	2	0.5	
Analyze	1	1	0.5	
Evaluate	1	0.5		
Create	0.5			

*Attendance 2.5

SEE- Semester End Examination (30 Marks):

Bloom's Category	TEST (30)
Remember	12.5
Understand	09
Apply	3
Analyze	3
Evaluate	2.5
Create	

Course Code: PHARM 1102, Course Title: Pharmacognosy and Phytochemistry-I
Marks: 100 Credits: 03

Rationale: The course is designed to introduce the students with the basic area of pharmacognosy which will be applicable in advanced research on natural products.

Objectives:

- To make the students knowledgeable on the history and sources of both medicinal plants and animal.
- To orient the students with distribution and method of cultivation of medicinal plants and animals.
- To help they know the active constituents and chemical structures of medicinally active compounds.
- To orient the learners with the medicinal uses of traditionally used plants and animals.
- To develop skills on the identification test, preservation and understanding of adulteration of various crude drugs

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Apply the knowledge of pharmacognosy in the field of pharmacy.
CLO2	Ascertain the sources, chemistry and therapeutic uses of crude drugs and their chemical structure.
CLO3	Explain the procedures of plant analysis.
CLO4	Demonstrate the lipids, carbohydrates, volatile oils, terpinoids and related plant compounds along with their source and pharmaceutical uses.
CLO5	Demonstrate the role of traditional medicine in therapeutic uses, and the development of modern medicine
CLO6	Recognize the use of surgical dressings and fibers.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2									
CLO2	3									
CLO3	3									
CLO4	3									
CLO5	3									
CLO6	2									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Introduction to Pharmacognosy:** Definition, scope and historical development of Pharmacognosy. Plant cell: Its structure, function and form, introduction to the general structure of the morphological parts of the plants.	4	CLO1

02	**Crude Drugs:** A general view of their origin, distribution, cultivation, collection, drying and storage, commerce and quality control, classification of drugs, preparation of drugs for commercial market, drug adulteration, evaluation of crude drugs.	5	CLO1 CLO2 CLO3
03	**Plant Analysis:** Extraction, separation, chromatography; types of plant constituents, comparative phytochemistry and chemotaxonomy	5	CLO3
04	**Lipids:** Definition, classification, properties and extraction of the following- a) Plant origin: castor oil, coconut oil, linseed oil, olive oil, peanut oil and chaulmoogra oil. b) Animal origin: cod liver oil, shark liver oil, hilsha fish/liver oil etc. c) Waxes	5	CLO1 CLO4
05	**Carbohydrate and Related Compounds:** Definition, classification, properties and biosynthesis. a) Monosacharides and oligosaccharides: Sucrose, dextrose, glucose, fructose etc. b) Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose, etc.	5	CLO1 CLO4
06	**Contribution of Traditional Drugs to Modern Medicines:** Details of some common indigenous traditional drugs: punarnava, vashaka, anantamul, arjuna, chirata, picrorhiga, kalomegh, amla, asoka, bahera, haritaki, tulsi, neem, betel nut, joan, karela, shajna, carrot, bael, garlic, black cumin, jam and madar.	5	CLO1 CLO5
07	**Volatile Oils and Related Terpenoids:** Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oil. The details of the following: i) Terpenes or sesquiterpenes: Turpentine, juniper, cade. ii) Alcohol's: Coriander, sandalwood, rose. iii) Ester: Peppermint, lavender, rosemary. iv) Aldehydes: Cinnamon bark, lemon peel, lemon grass. v) Ketones: Spearmint, caraway, dill, camphor. vi) Phenols: Clove, thyme, cinnamon leaf, ajowan vii) Ethers: Fennel, nutmeg, eucalyptus, anise, cajunut. viii) Peroxides: Chenopodium. ix) Others: Wintergreen, bitter almond.	9	CLO1 CLO2 CLO4
08	**Surgical Dressings and Fibers:** Classification, importance and brief study of different types of surgical dressings and fibers.	4	CLO1 CLO6

Text books:

1. Trease and Evan's Pharmacognosy: W.C. Evans.
2. Pharmacognosy: Varro E. Tyler, Lynn R. Brady, James E. Robbers

Reference books:

1. Pharmacognosy: E. P. Claus and V.E. Tyler.
2. Textbook of Pharmacognosy: Mohammed Ali.
3. Text book of Pharmacognosy: M. A. Ghani.
4. Indian Medicinal Plants: K. R. Kirticar, B. D. Basu.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLO	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Introduction to Pharmacognosy	Lecture, PPT Demonstration, Group discussion	Exam script evaluation, Class test, Quiz, assignment
CLO1 CLO2 CLO3	Crude Drugs	Lecture, PPT Demonstration, Group discussion	Exam script evaluation, Class test, Quiz, assignment
CLO3	Plant Analysis	Lecture, PPT Demonstration, Group discussion, Question-Answer session	Exam script evaluation, Class test, Quiz, assignment
CLO1 CLO4	Lipids:	Lecture, PPT Demonstration, Group discussion	Exam script evaluation, Class test, Quiz, assignment
CLO1 CLO4	Carbohydrate and Related Compounds:	Lecture, Online VDO, Discussion, Group study for problem analysis	Exam script evaluation, Class test, Quiz, assignment
CLO1 CLO5	Contribution of Traditional Drugs to Modern Medicines	Lecture, PPT Demonstration	Exam script evaluation, Class test, Quiz, assignment, Presentation
CLO1 CLO 2 CLO4	Volatile Oils and Related Terpenoids	Lecture, PPT Demonstration, Group discussion	Exam script evaluation, Class test, Quiz, assignment
CLO1 CLO6	Surgical Dressings and Fibers	Lecture, PPT Demonstration, Group discussion	Exam script evaluation, Class test, Quiz, assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 35)	Tests (20)	Assignments (10)	Presentation/ Quizzes (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	10		2	
Understand	3	5	3	
Apply				
Analyze	3			
Evaluate	4	5		
Create				

*Class Attendance: 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	30
Understand	20
Apply	
Analyze	5
Evaluate	5
Create	

Course Code: PHARM 1103 Course Title: Pharmaceutical Inorganic Chemistry-I
Marks: 100 Credits: 03

Rationale: To acquire the basic knowledge of inorganic pharmacy about atomic structure, chemical bonds, electrolytes, metals and periodic tables.

Objectives:

- Gain a better understands the relevance and significance of inorganic pharmacy to pharmaceutical sciences.
- Develop an understanding of the range and chemistry of elements in the periodic table Understand the medicinal and pharmaceutical importance of inorganic compounds.
- Apply the bonding fundamentals for both ionic and covalent compounds.
- Analyze geometries of simple molecules.
- Evaluate group theory to recognize and assign symmetry characteristics to elements.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Learn the fundamental structure of an atom and compare and contrast the proposed atomic theories.
CLO2	Learn to gain an insight into the entire class of chemical reactions, bonds, and their physical properties.
CLO3	Develop the understanding of periodic table and variation of properties within periods of groups of elements.
CLO4	Compare the importance of inert gases, essential electrolytes, and essential trace elements
CLO5	Learn about electronic concepts of different chemical bonds formation.
CLO6	Understand different shapes of molecules.
CLO7	Understand the properties of different transition metals.
CLO8	Know the application of complex compound in medicine and daily life.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	3	3						
CLO2	3	2	3	3						
CLO3	3	2	3	3	1					
CLO4	3	2	3	3						
CLO5	3	2	3	3						
CLO6	3	2	3	3						
CLO7	3	2	3	3						
CLO8	3	2	3	3						

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Atomic Structure:**Introduction of atomic structure, Atomic orbitals and quantum numbers, Proposed Atomic orbital theories, Orbitals chemistry (Shapes of atomic orbitals).	8	CLO1, CLO2
02	**Elements of periodic table:**The history of the periodic table, The basics of the periodic system, Pharmaceutical Applications ofInert gases, and Sources, isolation of inert gases from dry air (chemical method) and liquid air (physical method),types of compounds formed by inert gases.Electrolytes (Na, K, Ca and Cl ions), used in replacement therapy, acid – base balance therapy, and combination therapy of electrolytes. Importance of essential trace elements (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.) in biological systems.	12	CLO3, CLO4
03	**Chemical Bonding:** Bonding and non-bonding electrons, electronic theory of valency, ionic bond, covalent bond, coordinate covalent bond, octet rules, characteristics of ionic, covalent and coordinate covalent compounds, Van der Wall's force, polar covalent bonds – hydrogen bond, metallic bond, theories of covalent bonding and hybridization.	10	CLO5, CLO6
04	**Coordination Compounds and Complexation:** Ligands or co-ordinating groups, monodentate or unidentate ligands, polydentate ligands, co-ordination number, co-ordination sphere, chelation, factors affecting the stability of metal complexes, application of chelate formation, isomerism of co-ordination compounds, valence bond theory, application of complexes in pharmacy.	10	CLO7, CLO8

Text Book:

1. S. Z. Haider : Introduction to Modern Inorganic Chemistry

Reference books:

1. Satya Prakash, Tuli, Basu and Madan : Advanced Inorganic Chemistry
2. R.D. Madan : Modern Inorganic Chemistry
3. B.R. Puri and L.R. Sharma : Principles of Inorganic Chemistry

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Atomic Structure	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2	Atomic Structure	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO3	Elements of periodic table	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	Elements of periodic table	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO5	Chemical Bonding	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO6	Chemical Bonding	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO7	Coordination Compounds and Complexation	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO8	Coordination Compounds and Complexation	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (20 out of 28)	Tests (20)	Assignments (10)	Quiz/Presentation (5)	External Participation inCurricular/Co-Curricular Activities (0)
Remember	4		2	
Understand	6	4	2	
Apply	6	4	1	
Analyze	2	2		
Evaluate	2			
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	20
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	5

Course Code: PHARM 1104 Course Title: Pharmaceutical Organic Chemistry-I
Marks: 100 Credits: 03

Rationale: Understanding the chemistry and reactions of organic compounds.
Objectives:

- To gather knowledge about history, properties, structure and chemistry of organic compound.
- To understand the basic reactions of organic molecules.
- To know different importance of organic molecules in daily life.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Discuss the history, properties, structure and chemistry of organic compound.
CLO2	Demonstrate the basic understanding of the reactivity of organic molecules.
CLO3	Explain how organic compounds play important role in daily life.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	**3**	**2**								
CLO2	**3**	**3**								
CLO3	**3**	**3**								

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Introduction to Organic Chemistry:** History of organic chemistry, classification of organic compounds, systematic naming of organic compounds, electronegativity, polarity of molecules, structure and physical properties, intermolecular forces, inductive effects, bond length, bond angles and bond	3	CLO1

	strength, carbonium ions, carbanions, electrophiles, nucleophiles, free radicals, hydrogen bonding, melting point, boiling point, solubility of organic compounds etc. Aromaticity, benzene and substituted benzenes, electrophilic aromatic substitution etc.		
02	**Chemistry of Aliphatic Compounds:** **a) Alkanes, Alkenes and Alkynes**: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications of alkanes, alkenes and alkynes. **b) Aldehydes and Ketones:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications. **c) Alcohols, Ethers and Epoxides:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications. **d) Carboxylic Acids:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications. **e) Amines:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications. **-** homogenous compounds- Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.	3	CLO2
03	**Chemistry of Aromatic Compounds:** Aromaticity, mechanism of orientation and substitution and resonance preparations, reactions and pharmaceutical importance of simple aromatic compounds, aromatic halogen compounds, aromatic nitro compounds, aromatic amino compounds, diazonium salts and related compounds, sulphonic acids, phenols, alcohols, aldehydes, ketones and aromatic acids.	3	CLO2
04	**Carbohydrates:** **a) Monosaccharides and Disaccharides:** Nomenclature, classifications, general reactions, configurations and pharmaceutical importance of monosaccharides and disaccharides. **b) Polysaccharides:** Composition, structure, properties and pharmaceutical importance of starch and cellulose.	3	CLO3

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies

CLO1	Introduction to organic chemistry	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2	Chemistry of aliphatic and aromatic compounds	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3	Carbohydrate	Lecture, Question-Answer session	Class test (Short Q and MCQ)

Text Book:

1. B.S. Bahl and Arun Bahl, Advanced Organic Chemistry

References books:

1. Advanced Organic Chemistry: B.S. Bahl and Arun Bahl
2. Organic Chemistry: R.T. Morrison and R.N. Boyd
3. Organic Chemistry Vol. I & II: I.L. Finar
4. Medicinal Chemistry: Ashutosh Kar

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	6		2	
Understand	4	2	4	
Apply	4	2	4	
Analyze	4			
Evaluate	2			
Create		1		

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	15
Apply	15
Analyze	10
Evaluate	5
Create	0

Course Code: PHARM 1105 Course Title: Physical pharmacy-I
Marks: 100 Credits: 03

Rationale: This is a basic course of Bachelor of Pharmacy program that provides basic information of the physicochemical properties of solutions and gases.

Objectives:

- To provide knowledge about physicochemical properties of drug molecules in the different states
- To impart knowledge Thermochemistry and all laws of thermodynamics
- To provide an understanding regarding pH, buffer, and buffer capacity and their importance in pharmaceutical formulation

Course Learning Outcomes: at the end of the Course, the Student will be able to-

CLO1	To understand various physicochemical properties of drug molecules in the different states
CLO2	To explain chemical and phase equilibria
CLO3	To know gas laws and their applications in pharmacy
CLO4	To understand various states of elements and know about their properties
CLO5	To know the pH, buffer, and buffer capacity and their importance in pharmaceutical formulation
CLO6	Share the details on different types of solution and solution properties
CLO7	To comprehend Thermochemistry and all laws of thermodynamics

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	3	3	3		2	1	3	3	1
CLO2	3			2	1	3	3	3	
CLO3	2	1			3	3	1	1	
CLO4	2		3						
CLO5	3		3					3	1

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Content**	**Hrs.**	**CLOs**
01	**Chemical Equilibria:** Law of mass action, criteria of chemical equilibrium, application of law of mass action to omogenous and heterogeneous equilibrium, factors affecting equilibrium, Gibb's free energy change for chemical equilibria, Le-Chatelier principle and its industrial application, Vant Hoff equation.	6	CLO1

02	**Chemical Thermodynamics:** System, the first law of thermodynamics, work, energy, heat and enthalpy, work of expansion, internal energy, determination of internal energy, Second law of thermodynamics, the concept of entropy and entropy changes, heat change at constant volume and constant pressure, reversible, irreversible, isothermal and adiabatic changes, molar heat capacity, difference between molar heats, Joule- Thomson experiment. **Fundamentals of thermochemistry:** Exothermic and endothermic reactions, thermochemical equation, heat of reaction, Laplac's and Hess's laws and its applications, bond energies.	6	CLO2 & CLO3
03	**Phase Equilibria:** Phase, components and degree of freedom, , phase rule of one and two component system, triple point, aziotrope mixture, critical solution temperature (CST), eutectic mixture, fractional distillation, freeze drying (lyophilization).	7	CLO5 & CLO4
04	**Solution:** Types and properties of solution, units of concentration, ideal and real solution, Henry's law, distribution of solids between two immiscible liquids, distribution law, partition coefficient, solvent extraction. Colligative properties of dilute solution, osmotic pressure, measurement of osmotic pressure, coefficients for expressing colligative properties.	7	CLO2 & CLO3
05	**Properties of matters:** (a) The gaseous state- Ideal gas laws and their derivation. Dalton's law of partial pressure. Kinetic theory of gases. Liquefaction of gases (b) The liquid state- vapor pressure of liquids and effects of ambient conditions like Temperature on vapor pressure (c) The solid state: i) Crystals: Definition, types and Methods of preparation of crystals and their applications in pharmacy. ii) Definition, Types of isomeric, polymorphic and amorphous substances and their applications in pharmacy. iii) Colloids: Definition, types and properties of colloids. iv) Pharmaceutical importance of colloids of early and current uses. v) Tests to identify: The forms and types of colloids (d) Aerosols–a brief theoretical knowledge about types and applications of Aerosols.	8	CLO1 & CLO4
06	**Buffer and Isotonic Solutions:** Buffer solution, buffer equations, buffers in pharmaceutical and biological systems, buffer capacity, isotonic, hypertonic and hypotonic systems, dialysis, methods of adjusting tonicity and pH.	4	CLO5

Text Book:

1. B.S. Bahl, D.G. Tuli and A. Bahl : Essentials of Physical Chemistry

Reference books:

1. M. M. Haque and M. A. Nawab : Principles of Physical Chemistry
2. A. Martin and J. Swarbrick : Physical Pharmacy
3. P.W. Atkins : Physical Chemistry
4. K.K. Sharma and L.K. Sharma : A Textbook of Physical Chemistry
5. N. Kundu and S.K. Jain : Physical Chemistry
6. S. H. Maron and C.F. Prutton : Principles of Physical Chemistry

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Chemical Equilibria	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO2, CLO3	Chemical Thermodynamics	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO4, CLO5	Phase Equilibria	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO2, CLO3	Solution	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO1, CLO4	Properties of matters	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), assignment
CLO5	Buffer and Isotonic Solutions	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	

Understand	5	3	2	
Apply	2	4	1	
Analyze	2	2	1	
Evaluate	2	1		
Create	1			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 1106 Course Title: Computer Applications in Pharmacy
Marks: 50 Credits: 02

Rationale: This course is designed to provide students with comprehensive information about computer and also its application in pharmacy.

Objectives:

- To introduce computer parts, classification and its applications.
- To understand the operating systems and programming languages of computers.
- To accumulate knowledge of networking in pharmacy fields.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Know the different parts of computer and its application in pharmaceutical sciences.
CLO2	Relate different software and programming languages to computer usage.
CLO3	Apply the knowledge of networking for pharmaceutical applications.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2								
CLO2	2	2			3					
CLO3	2									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	Introduction to Computers: Introduction to different parts of computer, application and scope of computer in pharmacy- drug discovery and development, formulation and dosage form research and development, hospital management, prescription and patient management, preclinical and clinical trials, biopharmaceutical data analysis, industry management, quality control and analysis, chemo-informatics and bioinformatics, drug information system etc. .	4	CLO1
02	Classification of Computer: Mainframe, mini and microcomputer, computer architecture- a general review of INPUT/OUTPUT media and devices, functional part and organization of central processing unit, memory and memory storage devices, microprocessors, number systems- binary, hexadecimal etc., hardware, software, batch processing, RAM, ROM etc..	4	CLO1
03	Operating Systems: Introduction to different types of operating system-Unix, MS-DOS, WINDOWS, OS 2 WARP etc, introduction to word processing software (MS Word, WordPerfect etc), introduction to analytical software (SPSS).	2	CLO2
04	Programming Languages: Introduction to machine language, interpreter, compiler, assembler language; High level language- basic, C++, PASCAL, FORTRAN etc, algorithm, flowchart, decision table, basic idea of programming, data file and data base.	2	CLO2
05	Introduction to Computer Network: Internet and netsurfing using Netscape- basic principles, gateway and bridge, Internet Protocol (IP), protocol translation, information retrieval.	4	CLO3

Text Book:

1. Fundamentals of Computer: P.K. Sinha
2. Introduction to Computer Science: Jain, Satish
3. Fundamentals of Computer: V. Rajaraman
4. Elements of Computer Science: Balasubramanian
5. Introduction to computers. Author: Peter Norton

Reference books:

1. Fassett: Computer Applications in Pharmacy.
2. R. White: How computers work.
3. Ron Mansfield: Working in Microsoft Office.
4. V. K. Jain.: Basic Programming.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Introduction to different parts of computer and its application	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Quiz, assignment
CLO2	Operating system, windows, office applications, programming languages	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3	Computer network	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	Tests (20)	Assignments (5)	Quizzes (10)	External Participation inCurricular/Co-Curricular Activities (0)
Remember	2			
Understand	5	2	4	
Apply	5	2	4	
Analyze	5		2	
Evaluate				
Create		1		

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	Marks
Remember	5
Understand	25
Apply	25
Analyze	10
Evaluate	5

Course Code: PHARM 1107 Course Title: Pharmacognosy and Phytochemistry-I Lab
Marks: 50 Credits: 01

Rationale: The intent of the course is to describe the history, sources, distribution, method of cultivation, active constituents, medicinal uses identification test, preservation and adulteration of various crude drugs.

Objectives:

- To provide knowledge about morphological characteristics and chemical constituents of various crude.
- To impart practical knowledge about medicinal plants of Bangladesh.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Identify carbohydrates through various chemical test methods from crude drugs.
CLO2	Scrutinize starches and related products microscopically and chemically.
CLO3	Recognize the morphological characteristics and chemical constituents of various crude drugs.
CLO4	Examine gums and related products.
CLO5	Identify some medicinal plants in Bangladesh.

Mapping of Course Learning Outcomes (CLOs) to Program Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3								
CLO2	3	3								
CLO3	3	3								
CLO4	3	3								
CLO5	3	3								

Correlation: 3-High, 2-Medium, 1-Low

SL No.	Course Contents	Hrs	CLOs
01.	**1.** The cell, cell contents and cell types. **i.** The cell - (a) some cellular organism, chalk & diatomite. (b) Fungi- Mucor or rhizopus, aspergillus, pencillium, ergot and yeast. **ii.** Cell contents – Starches and derivatives, calcium carbonate, silica. **iii.** Cell types – Parenchyma and modifications – colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiatae stem, parenchyma-pericyclicfibres jute, xylem fibres and vessels-liquorice, tracheids-pinus wood.	8	CLO1
02.	Epidetamal cells and associated structures (trichomes stomata etc.), leaves of belladonna, mentha, rosemary, senna, Indian hemp, digitalis etc. Seed trichomes- cotton and nux-vomica seeds, cork cells- cascara sagrada.	4	CLO2
03.	Study of some groups of unorganized white and off-white powder and whole drugs: **a)** General tests for carbohydrates.	5	CLO3

	b) Preparation and examination of starches and related products. **c)** Examination of gums: Acacia, tragacanth, sterculia agar and alginates.		
04.	Study of some medical and poisonous plants of Bangladesh.	5	CLO4
05.	Pharmacognostic study of a few selected powdered drugs.	6	CLO5

Text Book:

1. Pharmacognosy: Varro E. Tyler, Lynn R. Brady, James E. Robbers

Reference books:

1. Pharmacognosy: E. P. Claus and V.E. Tyler.
2. Textbook of Pharmacognosy: Mohammed Ali.
3. Text book of Pharmacognosy: M. A. Ghani.
4. Trease and Evan's Pharmacognosy: W.C. Evans.
5. Indian Medicinal Plants: K. R. Kirticar, B. D. Basu.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	1. The cell, cell contents and cell types. i. The cell - (a) some cellular organism, chalk &diatomite. (b) Fungi- Mucor or rhizopus, aspergillus, pencillium, ergot and yeast. ii. Cell contents – Starches and derivatives, calcium carbonate, silica. iii. Cell types – Parenchyma and modifications – colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiatae stem, parenchyma-pericyclicfibres jute, xylem fibres and vessels-liquorice, tracheids-pinus wood.	Written test,Collectingdatathrough observation and experimentation and drawing conclusions of the experiments.
CLO2	Epidetamal cells and associated structures (trichomes stomata etc.), leaves of belladonna, mentha, rosemary, senna, Indian hemp, digitalis etc. Seed trichomes- cotton and nux-vomica seeds, cork cells- cascara sagrada.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Study of some groups of unorganized white and off-white powder and whole drugs: a) General tests for carbohydrates. b) Preparation and examination of starches and related products. c) Examination of gums: Acacia, tragacanth, sterculia agar and alginates.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Study of some medical and poisonous plants of Bangladesh.	Written test, Collecting data through observation and experimentation and

		drawing conclusions of the experiments.
CLO5	Pharmacognostic study of a few selected powdered drugs.	Written test, Quiz, Collecting data through observation and experimentation.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks)

Bloom's Category Marks (out of 15)	**Lab Performance Test (10)**	**Lab reports (05)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	1.5	2.5	
Understand	1	2.5	
Apply	1.5		
Analyze	1		
Evaluate	2.5		
Create	2.5		

*Lab Attendance 05

SEE- Semester End Examination (30 Marks)

Bloom's Category	**TEST (25)**	**Viva Voce (05)**
Remember	2.5	1
Understand	2.5	1
Apply	2.5	1
Analyze	2.5	1
Evaluate	7.5	1
Create	7.5	

Course Code: PHARM 1201Course Title: Pharmaceutics-I
Marks: 100 Credits: 03

Rationale: The purpose of this course is to provide the basic pharmaceutical knowledge on excipients, monophasic and biphasic liquid dosage forms, and semisolid drugs that will enable the students to be skillful on liquid and semisolid drug manufacturing.

Objectives:

- To introduce the students with various excipients and their functions.
- To orient the students about the principle of and manufacturing procedure of syrup, suspension, emulsion, ointment, cream, paste and gels.

- To make them skillful on the finding the potential problems and subsequent correction during the manufacturing of syrup, suspension, emulsion, ointment, cream, paste and gels.
- To make the students help on compounding and dispensing of drugs.

Course Learning Outcomes (CLOs): at the end of this course, students will be able to-

CLO1	Make the students to understand about various types of excipients with their physical and chemical properties.
CLO2	Help them conceptualize knowledge about liquid dosage form.
CLO3	Accumulate basic ideas abouttheories and formulation in dispersed systems.
CLO4	Accumulate basic ideas abouttheories and formulation in semisolid dosage form.
CLO5	Facilitate necessary knowledge about basic principles of compounding and dispensing

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	**3**	**2**			**2**					
CLO2	**2**	**2**			**2**	**2**	**2**			
CLO3	**2**	**2**			**2**					
CLO4	**3**	**2**			**2**	**2**	**2**			
CLO5	**3**	**2**			**2**					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Pharmaceutical Excipients:** Chemistry, physical properties and uses of antimicrobial preservatives, acidifying agents, alkalizing agents, antioxidants, buffering agents, complexing agents, suspending agents, emulsifying agents, air displacement agents, antifoaming agents, humectants, ointment bases, coloring agents, flavoring agents, solvents and co-solvents stiffening agents, wetting and solubilizing agents.	8	CLO1
02	**Liquid Dosage Forms:** Various liquids for external, oral and paranteral use, Clear liquids and solutions- physicochemical considerations, types of solution dosage form, solution and elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation and manufacturing considerations, additives, solubilizers, colors, flavors and other excipients that are used in formulations, packaging of liquids, preservation and stability aspects and quality control systems of liquids.	8	CLO2
03	**Dispersed System:** a) Properties of Dispersed Systems: Theoretical aspects of suspension, emulsion and colloids, interfacial properties of	12	CLO3

	suspended particles, surface charge activities and zeta potential, theory of sedimentation, effect of Brownian movement, suspending and emulsifying agents, Inter- particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence. b) Suspension: Definition and application, advantage and disadvantages, aggregated and dispersed system, formulation, manufacturing and stability, evaluation and quality control, rheological consideration, illustrative examples. c) Emulsion: Definitions and applications, advantage and disadvantages, classification of emulsion, theory of emulsion, formation of emulsion, classification of emulsifying agents, HLB values of surface active agents, formulation manufacturing, stability and evaluation, rheological considerations		
04	**Semisolids (Ointments, Paste, Gels, etc.):** Structure of skin, percutaneous absorption of drugs, factors influencing penetration of drug tHourough skin, definition and classification of semisolid, classification of ointment bases, formulation and manufacturing of ointments, pastes and gels, rheological considerations, evaluation and quality analysis	7	CLO4
05	**Pharmaceutical compounding and dispensing**	7	CLO5

Text book:

1. Pharmaceutics: The Science of Dosage form Design: Michael Aulton.
2. Lachman L., Liberman H. A., Kaing J. L. 1976. The Theory and Practice of Industrial Pharmacy. 3rd edition, Varghese publishing House, Bombay.

Reference books:

1. Lewis W. Dittert., 1974. Sprowl's American Pharmacy. J.B. Lippincott Company, Philadolphia, Toronto.
2. Cutter S. J., 1987. Cooper and Gunn's Dispensing for Pharmaceutical Students. 12th Edition. CBS Publishers.
3. Pharmaceutical Dosage Forms and Drug Delivery Systems: Howard C. Ansel.
4. Martin E. W. 1960, Husa's Pharmaceutical Dispensing. Mack Publishing company, Pennsylvania.
5. Rawlins E. A., 2001, Bently's Textbook of Pharmaceutics. 8th edition.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	Topic	Teaching-Learning Strategies	Assessment Strategies

CLO1	Pharmaceutical Excipients	Lecture, PPT Demonstration, Group discussion	Answer Script evaluation, Class test Quiz, Assignment, Presentation
CLO2	Liquid Dosage Forms	Lecture, PPT Demonstration, Group discussion	Answer Script evaluation, Class test Quiz, Assignment, Presentation
CLO3	Dispersed System	Lecture, PPT Demonstration, Group discussion	Answer Script evaluation, Class test Quiz, Assignment, Presentation
CLO4	Semisolids (Ointments, Paste, Gels, etc.)	Lecture, PPT Demonstration, Group discussion	Answer Script evaluation, Class test Quiz, Assignment, Presentation
CLO5	Pharmaceutical compounding and dispensing	Lecture, PPT Demonstration, Group discussion	Answer Script evaluation, Class test Quiz, Assignment, Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 35)	Tests (20)	Assignments (10)	Presentation / Quiz (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	5			
Understand	5		2	
Apply	5	5	3	
Analyze	3	5		
Evaluate	2			
Create				

*Class Attendance: 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	

Course Code: PHARM 1202 Course Title: Pharmacognosy and Phytochemistry-II
Marks: 100 Credits: 03

Rationale: The intent of the course is to describe the history, sources, distribution, method of cultivation, active constituents, medicinal uses identification test, preservation and adulteration of various crude drugs.

Objectives:

1. To provide knowledge about Identification of the natural products, their origin, properties and biological activity and to utilize the knowledge of Pharmacognosy in the related fields of Pharmacy.
2. To impart knowledge about Ayurvedic, Unani, and Homeopathy system of medicines

Course Learning Outcomes (CLOs): at the end of this course, students will be able to-

CLO1	Identify the natural products, their origin, properties and biological activity. To utilize the knowledge of Pharmacognosy in the related fields of Pharmacy. To know the natural resources for pharmacy
CLO2	Explain the role of phytochemical compounds in the related field of pharmacy.
CLO3	Demonstrate the role of natural products as the source of many drugs and pharmaceutical ingredients.
CLO4	Recognize the poisonous plants found in nature and their harmful effects.
CLO5	To know about Ayurvedic, Unani, and Homeopathy system of medicines.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3				1					
CLO2	3				3					
CLO3	3				3					
CLO4	3									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Phytochemistry and Pharmaceutical Uses of the Following Plant Constituents:** **Glycosides and Glycoside-containing Drugs**: Classification and biosynthesis of glycosides. The details of the following: a) Phenols and phenolic glycosides. i) Simple phenols: Vanilla and vanillin, capsicum ii) Tannins: Galls or nutgall, hamamelis. iii) Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb. b)Saponins, cardioactive drugs and other steroids.	9	CLO1, CLO2, CLO3

	i) Steroidal saponin: Sarsaparilla root, ginseng, glycerhizia. ii) Pentocyclictriterpenoidsaponin. iii) Cardioactive glycosides: Digitalis, strophanthus, squill. iv) Cyanogenic glycoside: Wild cherry, mustard. v) Miscellaneous isoterpenoids: Gentain, valerian root, quassia, fish berries, santonica flower, saffron. c) Other glycosides (alcohol, aldehyde, lactone, phenol, flavonoid) and neutral principles: Willow bark, Vanilla, Cantharide, Uvaursi, Gentian, Quassia, Saffron etc.		
02	**Phytochemistry and Pharmaceutical Uses of the Following Plant Constituents:** **Alkaloids:** Classification and biosynthesis of tropane, quinoline, isoquinoline and indole alkaloids. The details of the following: i) Tropane: Belladona, stramonium, hyoscyamus and coca leaf. ii) Quinoline: Cinchona, cusparia bark. iii) Isoquinoline: Ipecac, opium, sanguinaria, curare. iv) Indole: Rauwolfia, nux vomica, ergot, catharanthus. v) Imidazole: Pilocarpine. vi) Steroidal: Veretrumviride, aconite. vii) Norlupinane: Lupinus sp. viii) Purine base: Coffee, tea and cocoa.	9	CLO1, CLO2, CLO3
03	**Phytochemistry and Pharmaceutical Uses of the Following Plant Constituents:** **Resin and Resin Combinations (e.g. resin, oleoresin, oleo gum resin, balsam):** Definition, chemistry, uses in pharmacy; brief study of podophyllum, jalap, cannabis, capsicum, ginger, myrrh, tolu balsam, and benzoin:	6	CLO1, CLO2, CLO3
04	**Herbs as Health Foods:** Definition, chemistry, uses in pharmacy; brief study of alfaalfa, apricot pits, arnica, garlic, onion, ginseng, ginkobiloba, spiriluna, fenugreek, sassafras, honey etc.\	7	CLO1, CLO2, CLO3
05	**Poisonous Plants and Natural Pesticides:** Datura, poison hemlock, water hemlock, ipomoea, tobacco, pyrethrum flower, derris and lonchocarpus, strychnine, neem etc.	7	CLO1, CLO4, CLO5

Text Book:

1. M. A. Ghani: Text book of Pharmacognosy

Reference books:

1. E. P. Claus and V.E. Tyler: Pharmacognosy
2. W.C. Evans: Trease and Evan's Pharmacognosy
3. C K Kokate, A P Purohit: A text book of Pharmacognosy
4. Mohammed Ali: Textbook of Pharmacognosy

5. K. Raghunathan and Roma Mitra: Pharmacognosy of Indigenous Drugs Vol. I & II
6. R. N. Chopra, S. L. Nayer: Glossary of Indian Medicinal Plants

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1, CLO2, CLO3	Phytochemistry and Pharmaceutical Uses of the various Plant Constituents	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO1, CLO2, CLO3	Herbs as Health Foods	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO1, CLO4, CLO5	Poisonous Plants and Natural Pesticides	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes/ Presentation (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	8		1	
Understand	5	3	2	
Apply	4	4	1	
Analyze	2	2	1	
Evaluate	1	1		
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	20
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	5

Course Code: PHARM 1203 CourseTitle: Pharmaceutical Microbiology
Marks: 100 Credits: 03

Rationale: The course is designed to introduce the young learners with the basic area of microbiology such as bacteria, virus, fungus, Rickettsiae, and immunity of human body.

Objectives:

- To orient the students with the historical development of microbiology.
- To help them understand on morphology, classification and chemical composition of microbs.
- To understand the students about growth pattern, nutritional requirement, types of culture and cultivation of microorganisms.
- To make them skilled on the identification and preservation of microorganisms.

Course Learning Outcomes (CLOs): At the end of this course, students will be able to-

CLO1	Basic knowledge of microbiology related to some terminology, nomenclature, nature of microorganisms
CLO2	Morphology, types, characteristics, culture, significance of microorganism
CLO3	Identify and cultivate microorganisms
CLO4	Various types of sterilization and their advantages
CLO5	Concept of Immunity and functions of immune cells, vaccines and sera.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2									
CLO2	3									
CLO3	3									
CLO4	3									
CLO5	3									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course content**	**Hrs**	**CLOs**
01.	Introduction to Microbiology: Definition, microbiology as a field of biology, place of microbiology in the living field, prokaryotic and eucaryotic protests, group of microorganisms– nomenclature, type and nature,, areas of microbiology, scope of microbiology with special reference to pharmaceutical sciences.	3	CLO1
02.	Bacteria: a) Nomenclature of bacteria, general characteristics of bacteria. b) General and cellular morphology - size, shape, fine structures and movement. c) Cultivation of bacteria: nutritional requirements, factors affecting growth, bacteriological media.	3	CLO2 , CLO3

	d) Reproduction and growth: Modes of cell division, normal growth cycle, growth curve, syncHouronous growth and quantitative measurement of growth. e) Pure culture and cultural characteristics: Methods of isolation, maintenance and preservation of pure cultures, colony characteristics and characteristics of broth culture, maintenance and preservation of pure culture of bacteria. f) Microbial metabolisms: Introduction, metabolic versatility of organisms, enzymes, energy production by aerobic & anaerobic processes, fermentation processes. g. Disinfectant, Antiseptics and Preservatives: Introduction to disinfectant, factors influencing disinfectant, chemical disinfectants, and their modes of action, disinfectant evaluation. Manufacture of alcoholic beverages and enzymes of medical importance.		
3.	**Virus:** a) History of viruses, general properties of viruses, classification of viruses, characteristics of viruses, reproduction and cultivation of viruses, virus inhibition, control of viral infections. b) Bacterial virus or bacteriophages: Morphology, composition and life cycle, cultivation of bacterial viruses, virus & diseases, applications in life sciences.	5	CLO2 , CLO3
4.	**Fungi and Rickettsiae:** pharmaceutical importance, characteristics, morphology, reproduction (sexual & asexual), cultivation, classification of fungi, some fungi of special interest (Penicillium, Candida, Aspergillus, Rhizopus), diseases caused by fungi. characteristics of rickettsiae, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases. Brief study of actinomycetes	8	CLO2 , CLO3
5.	**Sterilization:** a) Sterilization by dry heat- principle, hot air oven, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heat, principle of sterilization by stem under pressure, autoclave- applications, testing the efficiency of autoclaves, sterilization by heating with bactericides, validation of sterilizers. b) Sterilization by filtration c) Sterilization by radiation d) Sterilization by gas.	6	CLO4
6.	**Basic Concepts of Immunology:** Introduction, types of immune systems, non specific and specific components of the immune system, immuno regulation and diversity, types of immunity, Infections, pathogenicity and virulence immunity, hypersensitivity, Inflammation, autoimmunity, cancer immunotherapy, immunodiagnostics and immunological products (vaccines, toxoids, sera).	3	CLO5

Test Book:

1. Microbiology: M.J. Pelczar, E.C.G. Chan and N.R. Kreig
2. Medical Microbiology: G. F. Brooks Jawetz, Melnick and Adelberg's.

Reference books:

1. Medical Microbiology: C. A. Mims et al.
2. Pharmaceutical Microbiology: Blackwell Scientific publications, Oxford London.W.B. Hugo and A.D. Russel
3. Pharmaceutical Microbiology: Ashutosh Kar
4. Foundations in Microbiology: K. Park Talaro Arthur Talaro.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Introduction to Microbiology	Lecture, PPT Demonstration, Group discussion	Answer script evaluation, Class test, Quiz, assignment, Presentation
CLO2, CLO3	Bacteria	Lecture, Group Discussion	Answer script evaluation, Class test, quiz, presentation, assignment
CLO2, CLO3	Virus:	Lecture, Question-Answer session	Answer script evaluation, Class test, quiz, presentation, assignment
CLO2, CLO3	Fungi and Rickettsiae	Lecture, Discussion, Group study for problem analysis	Answer script evaluation, Class test, quiz, presentation, assignment
CLO4	Sterilization	Lecture, Discussion, PPT Demonstration	Answer script evaluation, Class test, quiz, presentation, assignment
CLO5	Basic Concepts of Immunology	Lecture, PPT Demonstration, Group discussion	Answer script evaluation, Class test, quiz, presentation, assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 35)	Tests (20)	Assignments (10)	Presentation/ Quizzes (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	10	3	2	
Understand	3	4	2	
Apply				
Analyze	2		2	
Evaluate	5	3		

Create			4	

*Attendance: 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	20
Apply	**5**
Analyze	5
Evaluate	5
Create	

Course Code: PHARM 1204 Course Title: Physiology and Anatomy-I
Marks: 100 Credits: 03

Rationale: Understanding the basic morphology, structure and functions of cell, tissues, organs and blood, respiratory, cardiovascular and digestive systems of human body that will advanced to students to learn pharmacology and biopharmaceutics.

Objectives:

- To orient the young learners with the cells and tissues.
- To help them knowledgeable on various organ systems and their functions.
- To orient the students with some disease of the respective system.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Explain various organs of different systems of human body.
CLO2	Illustrate the gross morphology, structure and functions different system of the body.
CLO3	Summarize the mechanisms in the maintenance of normal functions of the human body.
CLO4	Become familiarized with different parts of Cardiovascular system
CLO5	Explain the function and structure of gastrointestinal system.
CLO6	Achieve the knowledge regarding common function of Respiratory system.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2				2					
CLO2	2				2					
CLO3	3					2				
CLO4	3				2					
CLO5	3									
CLO6	3									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Introductory Physiology and General Physiology:** Physiology and its scope in pharmacy, RNA, DNA, body fluid compartments and composition of body fluid, transport across cell membrane and membrane potentials, intercellular communication and homeostasis.	5	CLO1 CLO2
02	**Cell and Tissue:** Structure and function, cell inclusions, division of cells; Tissue: Definition, classification, structure and function of epithelial tissues, connective tissue, muscular tissue and nervous tissue.	5	CLO2
03	**Blood System:** a) Plasma: electrolytes, proteins and other organic constituents; b) Blood cells: Formation and destruction, cell constituents, functions of different blood cells. c)Haemoglobin: Structure and function, haemoglobinopathy, thalassemia; anaemia-causes and classification; blood coagulation and anticoagulation, blood group andtransfusion, type of blood vessels and their function. d) Lymph: composition, circulation and function, lymph nodes and lymphatics.	8	CLO3
04	**Cardiovascular System:** Heart- structure and blood circulation, cardiac muscles and their properties, origin of heart beat and action potential, cardiac cycle, heart sounds, cardiac output, ECG, regulation of cardiac function, blood pressure- types, significance, measurement and regulation, hypertension- types and causes.	8	CLO4
05	**Digestive System:** Structure of different parts of alimentary system, gastrointestinal motility and its control, swallowing and defaecation; secretion of digestive juices from saliva, stomach, pancreas; functions of digestive juices and their mechanism and regulation of secretions; digestion and absorption of various food stuffs; liver and its function, formation of bile and its circulation	8	CLO5
06	**Respiratory System:** Organs of respiratory system and its structure, inspiration and expiration, mechanism of respiration, pulmonary ventilation, ventilation volumes, gaseous exchange through lungs, transport of O_2 and CO_2, hypoxia and eschemia- causes and classification.	8	CLO6

Text Book:

1. Medical Physiology: Guyton
2. Human Physiology (vol. I & II): C.C. Chatterjee

References books:

1. Medical Physiology: Ganon.
2. Practical Physiology: C. L. Ghai.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1 CLO2	Introductory Physiology and General Physiology	Lecture, PPT Demonstration, Group discussion	Answer script evaluation, Class test, Quiz, assignment
CLO2	Cell and Tissue	Lecture, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment
CLO3	Blood System	Lecture, Assignment, presentation Question-Answer session	Answer script evaluation, Class test, Quiz, assignment, Presentatioon
CLO4	Cardiovascular System	Lecture, Online VDO, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment
CLO5	Digestive System	Lecture, Online VDO, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment
CLO6	Respiratory System	Lecture, Online VDO, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 35)	Tests (20)	Assignments (10)	Presentation/ Quizzes (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	8			
Understand	5	5	2	
Apply	3	5	3	
Analyze	2			
Evaluate	2			
Create				

*Class Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	25
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	

Course Code: PHAR 1205 Course Title: Pharmaceutics-I Lab
Marks: 100 Credits: 02

Rationale: This course is rationale for undergraduate students. The purpose of this course is to demonstrate the student's laboratory concept about formulation, preparation and evaluation of different liquid dosage forms such as solution, syrup, emulsion and suspension.

Objective:

- To make the students skillful on manufacturing of syrup, suspension, emulsion, solution, ointment, paste and gel in laboratory.
- To make the students skillful on evaluation of syrup, suspension, emulsion, solution, ointment, paste and gel in laboratory.

Course Learning Outcomes (CLOs): At the end of this course, the students will be able to-

CLO1	Develop skills on preparation of percentage solution
CLO2	Develop skills on preparation of aromatic water.
CLO3	Develop skills on preparation of syrup.
CLO4	Develop skills on preparation of suspension.
CLO5	Develop skills on preparation of emulsion
CLO6	Develop skills on preparation and evaluation of lotion.
CLO7	Develop skills on preparation and evaluation of cream.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	2	1			2					
CLO2	2	2			2		1			
CLO3	2	2			2		1			
CLO4	2	2			2		1			
CLO5	2				2					
CLO6	2				2					
CLO7	2				2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SLNo.	CourseContents	Hrs	CLOs
01	Preparation of percentage solution.	4	CLO1
02	Preparation of aromatic water.	4	CLO2
03	Preparation of syrup: (i) Iron Syrup (ii) Paracetamol Syrup (iii) Promethazine HCl syrup	12	CLO3
04	Preparation of suspension: (i) Antacid Suspension (ii) Paracetamol Syspension	10	CLO4
05	Preparation of emulsion and determination of type of emulsion (i) Castor oil emulsion (ii) benzyl benzoate emulsion	10	CLO5
06	Preparation and evaluation of lotion	8	CLO6
07	Preparation and evaluation of cream	8	CLO7

Test books:

1. M. E. Aulton : Pharmaceutical Practice

Reference books:

1. Remington- The Science & Practice of Pharmacy: Alfronso R. Gennaro
2. Dispensing for Pharmaceutical Students: Cooper & Gunn

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	Teaching-Learning Strategies	Assessment Strategies
CLO1	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments
CLO2	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments
CLO3	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments
CLO4	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments
CLO5	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments
CLO6	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments

CLO7	Lecture and Lab experiments, group discussion	Lab performance test, Written test and drawing conclusions of the experiments

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category Marks (out of 35)	Lab Performance Test (20)	Lab Report (10)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	2		
Understand	3		
Apply	4		
Analyze	4		
Evaluate	4		
Create	4		

*Lab Attendance: 10

SEE- Semester End Examination (60 Marks)

Bloom's Category	TEST (50)	Viva Voce (10)
Remember	5	4
Understand	5	3
Apply	5	3
Analyze	5	
Evaluate	10	
Create	20	

Course Code: PHARM 1206Course Title: Pharmaceutical Microbiology- Lab
Marks: 100 Credits: 02

Rationale: The rational of the course is to develop the basic skills on some microbiological techniques.

Objectives:

- To orient the students on maintaining the biosafety in microbiological examination.
- To make the students skillful on the bacterial and fungal media preparation.
- To make learners capable for identification of bacteria.
- To make the learners skillful for measuring the antimicrobial activity of marketed antibiotics that will eventually promote then to search new antimicrobial drugs.

Course Learning Outcomes (CLOs): At the end of this course, the students will be able to-

CLO1	Operate instruments of microbiology lab
CLO2	Prepare bacterial growth media
	Prepare fungal growth media

CLO3	Sterilize media and relevant substances
CLO4	Inoculate bacteria and fungus to media
CLO5	Determine sensitivity (zone of inhibition) of antibiotic and anti-fungal drug
CLO6	Identify bacteria
CLO7	Separation of Pure culture of Bacteria

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	**2**									
CLO2	**2**									
CLO3	**2**									
CLO4	**2**									
CLO5	**3**									
CLO6	**3**									
CLO7	**3**									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**COURSE CONTENT**	**Hrs**	**CLOs**
1.	Operation of incubator, laminar air flow, autoclave.	4	CLO1
2.	Preparation of Agar Media	4	CLO2
3.	Preparation of nutrient Agar Media	4	
4.	Preparation of broth Media	4	
	Preparation of potato dextrose agar Media		
5.	Sterilization of bacterial media and glassware	4	CLO3
6.	Inoculation of bacteria and fungus to the media	4	CLO4
7.	Determination of antibiotic (Penicillin, Tetracycline, Ciprofloxacin, Azithromycin, Kenamycin, etc.) / antifungal (fluconazole) sensitivity by disc diffusion method	20	CLO5
8	Gram-staining for identification of gram negative and gram positive bacteria.	4	CLO6
9	Demonstration of techniques for getting pure culture of microorganisms using streak plate method and spread plate method.	8	CLO2, CLO3, CLO4, CLO7

Text Book:

1. Manual of Practical Microbiology and Parasitology: P. Chakraborty and Nishith k. Pal
2. Practical Microbiology: R.C. Dubey and D.K. Maheshwari

Reference Books:

1. Handbook of Microbiological Quality Control in Pharmaceuticals and Medical Devices: Rosamund M. Baird, Norman A. Hodges, Stephen P. Denyer
2. Microbiology Laboratory Manual: James G. Cappuccino and Natalie Sherman

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO2	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO3	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO4	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO5	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO6	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO7	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 30)	Lab Performance Test (20)	Lab Report (10)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	5	5	
Understand	5	5	
Apply	2		
Analyze	3		
Evaluate	2		
Create	3		

*Lab Attendance: 10

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (50)	Viva Voce (10)
Remember	10	3
Understand	10	3
Apply	5	2
Analyze	5	2
Evaluate	10	
Create	10	

Course Code: PHARM 1207 Course Title: Pharmacognosy and Phytochemistry-II Lab
Marks: 50 Credits: 01

Rationale: The intent of the course is to describe the history, sources, distribution, method of cultivation, active constituents, medicinal uses identification test, preservation and adulteration of various crude drugs.

Objectives:

- To provide knowledge of medicinal plants, phytochemical including carbohydrates, extraction process and poisonous plants in pharmaceutical research work.
- To impart practical knowledge on laboratory process regarding collection, identification and extraction of medicinal plants.

Course Learning Outcomes (CLOs): at the end of the Course, the Student will be able to-

CLO1	To utilize the knowledge of medicinal plants, phytochemical including carbohydrates, extraction process and poisonous plants in pharmaceutical research work.
CLO2	To identify numerous medicinal plants.
CLO3	To gain knowledge on plant parts having medicinal values.
CLO4	To gain practical knowledge on laboratory process regarding collection, identification and extraction of medicinal plants.
CLO5	To learn how to make laboratory reports.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	3	3	3		2	1	3	3	
CLO2	3				1	3	3	3	
CLO3	2	1			3	3	1	1	
CLO4	2		3	2					
CLO5	3	3	3		3	3	3	3	3

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No	**Course Contents**	**Hrs**	**CLOs**
01	Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.	**2**	**CLO2**
02	Detection of adulterants, (i.e. cotton seed, seasame and arachis oils) in olive oil.	**2**	**CLO2**
03	Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.	**2**	**CLO3**

04	Examination of Cod liver oil and detection of vitamin A in Cod liver oil.	**2**	**CLO4**
05	Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.	**3**	**CLO1**
06	Isolation of lycopene from tomato Isolation of β –Carotene from carrot.	**2**	**CLO5**
07	Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.	**2**	**CLO5**
08	Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.	**3**	**CLO4**
09	Study of alkaloids and some alkaloid containing drugs: Belladonna, Strammonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nux vomica and Areca.	**6**	**CLO3**
10	Isolation of lactose from Cow's milk.	**2**	**CLO4**
11	Physical and chemical tests for honey.	**2**	**CLO4**
12	Extraction and tests of alkaloids, lipids etc.	**2**	**CLO4**
13	Test of tannins.	**2**	**CLO4**

Text Book:

1. Pharmacognosy: Varro E. Tyler, Lynn R. Brady, James E. Robbers

Reference Books:

1. Pharmacognosy: E. P. Claus and V.E. Tyler.
2. Textbook of Pharmacognosy: Mohammed Ali.
3. Text book of Pharmacognosy: M. A. Ghani.
4. Trease and Evan's Pharmacognosy: W.C. Evans.
5. Indian Medicinal Plants: K. R. Kirticar, B. D. Basu.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO2	Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Detection of adulterants, (i.e.cotton seed, seasame and arachis oils) in olive oil.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Study of volatile oils and some volatile oil containing drugs:	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

	Caraway, Clove, Cinnamon, Peppermint etc.	
CLO4	Examination of Cod liver oil and detection of vitamin A in Cod liver oil.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.	Written test, Quiz, Collecting data through observation and experimentation.
CLO5	Isolation of lycopene from tomato Isolation of β –Carotene from carrot.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO5	Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Study of alkaloids and some alkaloid containing drugs: Belladonna, Strammonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nux vomica and Areca.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Isolation of lactose from Cow's milk.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Physical and chemical tests for honey.	Written test, Quiz, Collecting data through observation and experimentation.
CLO4	Extraction and tests of alkaloids, lipids etc.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Test of Tannins	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks)

Bloom's Category Marks (out of 15)	Lab Performance Test (10)	Lab reports (05)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	1.5	2.5	
Understand	1	2.5	
Apply	1.5		
Analyze	1		
Evaluate	2.5		
Create	2.5		

*Lab Attendance 05

SEE- Semester End Examination (30 Marks)

Bloom's Category	TEST (25)	Viva Voce (05)
Remember	2.5	1
Understand	2.5	1
Apply	2.5	1
Analyze	2.5	1
Evaluate	7.5	1
Create	7.5	

Course Code: PHARM 1208 Course Title: Viva voce-I
Marks: 50 Credits: 01

Rationale: The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board.

Objective: This course gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Learn how to approach themselves before an interview board.
CLO2	Overcome the fear or nervousness of facing face to face interview or interaction.
CLO3	Present their concepts systematically in oral form.
CLO4	Prepare them for future job interview.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3								2	
CLO2	3								2	
CLO3	3									

CLO4									3	

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL NO	Course content	Hrs	CLOs
1.	Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire 1st year including semester I and semester II.	-	CLO1 CLO2 CLO3 CLO4

Text Book:

1. All books relevant to courses studied during first year first and second term.

Reference books:

1. Marc Dorio. Complete Idiot's Guide to the Perfect Interview. 2nd edition, 2000; Alpha Books.
2. Susan Hodgson. Brilliant Answers to Tough Interview Questions. 5th edition, 2015; FT Press

Course Code: PHARM 2101Course Title: Clinical Pathology
Marks: 100 Credits: 03

Rationale: The intent of the course is to build upon basic understanding of the pathogenesis of the common diseases including hemodynamic, inflammatory, infectious, metabolic, renal, respiratory, and neoplastic diseases in order to diagnose them from clinical scenarios by recognizing key manifestations.

Objectives:

- To understand pathologic basis of different diseases of human body.
- Toknow the mechanism of disease development and the causative agents of the diseases.
- Toknow about the diagnosis of diseases and the preventive measurements for various inflammation, wounds, infectious diseases etc.
- Tolearn about chronic disorders and raise social awareness about different chronic diseases.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	State the scopes of pathology, morphology of cell injured cells, causes of cellular injury, ways of cell adaptation during stress.
CLO2	Diagnose hemodynamic disorders such as edemea, hyperaemia, congestion, thrombosis, embolism, infarction, shock etc.

CLO3	Classify cancer, carcinogenic agents and state their cellular interaction.
CLO4	Understand how does cell response towards injury and inflammation.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2				2		1		
CLO2	3				2	2		1		
CLO3	2	2			2	2		2		
CLO4	3	2				2				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Introduction:** General considerations, core and scope of clinical pathology.	2	CLO1
02	**Acute & Chronic Inflammation:** Vascular changes, leukocyte extravasation & phagocytosis, chemical mediators, causes of chronic inflammation.	6	CLO1 CLO4
03	**General Adaptation, Cell Injury and Cell Death:** Hyperplasia, hypertrophy, atrophy, metaplasia, necrosis, apoptosis, intracellular accumulation, pathological calcification.	4	CLO1 CLO4
04	**Tissue Renewal, Regeneration and Repair: C**ontrol of normal cell proliferation and tissue growth, cell cycle and the regulation of cell replication, mechanisms of tissue and organ regeneration, extracellular matrix and cell-matrix interactions, healing by repair, scar formation and fibrosis.	8	CLO2 CLO4
05	**Diseases of the Immune System:** The normal immune response- innate and adaptive immunity, components of the immune system- cells, tissues, and selected molecules, hypersensitivity and autoimmune disorders, rejection of tissue transplants, immunodeficiency syndromes, amyloidosis..	8	CLO2
06	**Neoplasia:** Characteristics, grading and stages of cancer, metastasis, karyotype changes in tumour, carcinogenic agents and their cellular interaction, oncogenes and cancer, sarcomas.	6	CLO2
07	**Infectious Diseases:**Categories of infectious agents, special techniques for diagnosing infectious agents, new and emerging infectious diseases, agents of bioterrorism, transmission and dissemination of microbes, how microorganisms cause disease, viral infections, bacterial infections, fungal infections, parasitic infections.	8	CLO2

Text books:

1. Kumar, Abbas and Fausto: Robbins and Cotran Pathologic Basis of Disease

References books:

1. Russell J Greene, Norman D Harris: Pathology and Therapeutics for Pharmacists
2. Ursus-Nikolaus Riede, Martin Werner: Color Atlas of Pathology

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLO	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	General considerations, core and scope of clinical pathology.	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO1	Acute & Chronic Inflammation	White board, PPT presentation, self-study of relevant materials.	Quiz, written test and self-generated question solution.
CLO2	General Adaptation, Cell Injury and Cell Death	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ), assignment
CLO2	Diseases of the Immune System	White board, PPT presentation, self-study and case study.	Quiz,written test and problem identification & solution.
CLO2	Neoplasia	Lecture, Question-Answer session	Presentation
CLO2	Infectious Diseases	White board, PPT presentation, self-study and case study.	Quiz, written test and problem identification & solution.

ASSESSMENT PATTERNS:

CIE: Continuous Internal Evaluation (40 Marks)

Bloom's Category (out of 40)	Test (20)	Assignments (10)	Quizzes/ Presentation (5)	External Participation in Curricular/Co-Curricular Activities
Remember	10	2	1	
Understand	4	3	2	
Apply	4	4	1	
Analyze			1	
Evaluate	2	1		

Create				

*Class Attendance: 5

SEE: Semester End Examination (60 marks)

Bloom's Category	Marks
Remember	28
Understand	20
Apply	6
Analyze	
Evaluate	6
Create	

Course Code: PHARM 2102 Course Title: Pharmacology-I
Marks: 100 Credits: 03

Rationale: Understanding the basic terms of pharmacology, pharmacodynamics, pharmacokinetics and gastrointestinal agent.

Objectives:

- To impart students with the basic knowledge regarding drug action.
- To make students conceptualize with principles of pharmacokinetics and pharmacodynamics.
- To provide information about various drug-receptor signaling pathway.
- To help the students understand the pathogenesis and treatment of peptic ulcer.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	**Understand the concept of drug, medicine, dose, drug action and drug related toxicity.**
CLO2	**Understand the basic principles of pharmacokinetics and pharmacodynamics of drug in the body.**
CLO3	**Familiarize with the various drug-receptor signaling pathway and how a drug exhibits its action.**
CLO4	**Understand the basic concept of drug metabolism and various metabolic pathways.**
CLO5	**Understand the pharmacological actions of certain medicines on pathological state of cells and tissues of particular organ.**

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3				1					
CLO2		2								

CLO3	3	3			2					
CLO4		2			1					
CLO5		3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	Introduction to Pharmacology: Definition of pharmacology, drug, medicine and pro drug; pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, drug interaction, drug tolerance, drug dependence, drug abuse, idiosyncrasy, dose, dosage form, absorption, distribution, bioavailability, distribution, protein binding, metabolism & excretion, routes of drug administration.	8	CLO1 & CLO2
02	Basic Concept of Drug Action: Definition of drug action, different mechanisms of drug action, receptors, nature of receptors, drug antagonism, relation between drug dose & clinical response.	6	CLO2 & CLO3
03	Signaling Mechanism and Drug Action: Regulation of gene expression by intracellular receptors, Ligand regulated transmembrane enzymes, legand gated channels, G-proteins and secondary messengers, such as cyclic-AMP, calcium and phosphoinositides and cyclic-GMP interplay among signaling mechanisms.	10	CLO3 & CLO 5
04	Drug Metabolism: Various pathway of drug metabolism, metabolism of various group of drugs, factors affecting drug metabolism with special emphasis on aging, methods of studying drug metabolism, new aspects of drug metabolism.	7	CLO4
05	Drugs for Peptic Ulcer: General consideration, chemistry, absorption, modification, distribution and excretion. Antacids, H2 - receptor blockers, proton pump inhibitors, PG analogues, mucosal-protective agents.	8	CLO1, CLO3 & CLO5

Text Books:

1. H. P. Rang, M. M. Dale, J. M. Ritter: Pharmacology
2. B. G. Katzung: Basic and Clinical Pharmacology

Reference Books:

1. K. D. Tripathi: Essentials of Medical Pharmacology
2. R. A. Harvey and P. C. Champe: Lipponcott's Illustrated Reviews Pharmacology

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies

CLO1	Introduction to Pharmacology, Drugs for Peptic Ulcer	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2	Introduction to Pharmacology, Basic Concept of Drug Action	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO3	Basic Concept of Drug Action, Signaling Mechanism and Drug Action, Drugs for Peptic Ulcer	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	Drug Metabolism	Lecture, Question-Answer session	Class test (Short Q and MCQ), oral evaluation
CLO5	Signaling Mechanism and Drug Action, Drugs for Peptic Ulcer	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

Continuous Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes/ Presentation (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	4	2	2	
Apply	5	2	4	
Analyze	4			
Evaluate	3			
Create		1	2	

***Class Attendance: 05**

Semester Final Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	5

Course Code: PHARM 2103 Course Title: Pharmaceutical Inorganic Chemistry-II
Marks: 100 Credits: 03

Rationale: Understanding the knowledge about inorganic compounds and their applications in pharmaceutical sciences.

Objectives:

- To familiarize him /herself to different inorganic substances used in pharmaceutical preparations.
- To understand the mechanism and use of gastrointestinal agents, dentifrice, topical agents.
- To know the composition and use of different types of glass, water and different pharmaceutical aids used in pharmaceutical preparations.
- To understand the use of inorganic substances as radiopharmaceuticals.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Apply the knowledge of classification, composition and uses of various gastrointestinal agents, topical agents and dental products.
CLO2	Describe the importance of topical preparations, dental preparations, radiopharmaceuticals and their applications in the treatment of diseases.
CLO3	Apply the knowledge of classification, composition and uses of various types of glass, water, and different pharmaceutical aids used for pharmaceutical preparations.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			**2**			**1**		
CLO2	3	1			**3**			**2**		
CLO3	3	3			**2**			**1**		

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Hematinic Preparations:** Various types of iron and iron compounds, role of iron compounds in hematological crisis, official iron compounds.	4	CLO1, CLO2
02	**Pharmaceutically Acceptable Glass and Water:** (i) Various types of glass, their advantages and disadvantages, problems regarding glassware in pharmaceuticals. (ii) Water: Hardness of water, treatment of natural water- distilled water, demineralized water, and official waters.	4	CLO3

03	**Topical Agents:** Official agents used in different dermatological conditions–protectives, antimicrobial agents- hydrogen peroxide solution, potassium permanganate, boric acid, iodine preparations, sodium hypochloride solution, protein precipitants, astringent products.	8	CLO1, CLO2
04	**Gastrointestinal Agents:** Classification of inorganic gastrointestinal agents, systemic and non-systemic antacids, preparation and application of antacids, preparation and application of adsorbents and saline cathartics or laxatives.	6	CLO1, CLO2
05	**Dental Preparations:** Dental plaque and antiplaque agents, dental caries, fluorides and other anticaries agents (preparation and application), dentifrices, mouthwash and desensitizing agents.	4	CLO2,
06	**Radioactivity and Radiopharmaceuticals:** Introduction, types of radiation and their properties, radioactive decay, half-life, average life, modes of radioactive decay, interaction of radiation with matter, measurement of radioactivity, radiation hazard and radiological safety, biological effects of radiation, control of radiation exposure, storage of radioactive materials, medical applications of radionuclides, official radioactive compounds and their importance, toxicity of radioactive isotopes, Contrast Media- Barium sulfate, organoidine compounds.	6	CLO2
07	**Miscellaneous Agents:** Inhalants, respiratory stimulants, expectorants, emetics, antidotes, Pharmaceutical acids, bases, buffers, antioxidants, tabletting aids-lubricants, ligands, etc.	8	CLO2, CLO3,

Text Book:

1. Block, Roche, Soine and Wilson: Inorganic, Medicinal and Pharmaceutical Chemistry

Reference books:

1. Randy Hendrickson et. al.: Remington, The Science and Practice of Pharmacy
2. L. M. Atherden: Bentley and Driver's Textbook of Pharmaceutical Chemistry
3. H. S. Storker and S. L. Seager : Environmental Chemistry, Air and Water Pollution
4. Paragon press London: Roger's Inorganic Pharmaceutical Chemistry
5. Discher: Modern Inorganic Pharmaceutical Chemistry

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Gastrointestinal agents	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment

CLO2	Dental preparations, radiopharmaceuticals	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3	Pharmaceutically acceptable glass and water	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	
Understand	5	3	2	
Apply	2	4	1	
Analyze	2	2	1	
Evaluate	2	1		
Create	1			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 2104 Course Title: Pharmaceutical Organic Chemistry-II
Marks: 100 Credits: 03

Rationale: This provides the basic principles that govern the structure, synthesis, behavior and reactivity of organic substances.

Objectives:

- To familiarize him/herself with different approaches to organic reaction.
- To gather knowledge about different types of geometric isomerism and optical isomerism.
- To understand the basic principles of addition reaction, substitution reaction, elimination reactionandrearrangement reaction.

- To familiarize him/herself with different name reaction of organic chemistry.
- To understand the general concept about heterocyclic compounds ant its application in pharmaceutical science.
- To know different amino acids and proteins with its types, function and metabolism.
- To understand the synthesis and usages of some common drugs.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	State basic organic chemistry.
CLO2	Apply the concepts and principles to organic molecules and chemical processes.
CLO3	Interpret the synthesis and use of some common drugs.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3								
CLO2	2	3								
CLO3	3	3								

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Stereochemistry:** A general treatment of different types of isomerism, tautomerism, asymmetric synthesis, walden inversion, Geometric isomerism, chirality of molecules, optical isomerism.	6	CLO1, CLO2
02	**Reaction mechanisms:** (a) Addition reaction: Electrophilic; nucleophilic and free-radical; 1, 2- and 1, 4- addition. (b) Substitution reaction: Unimolecular (S_N1) and bimolecular (S_N2), stereochemistry of S_N1 and S_N2 reaction, free-radical. (c) Elimination reaction: Unimolecular (E1) and bimolecular (E2), stereochemistry of elimination reaction. (d) Rearrangement reaction: Hofmann, Claisen, Sigmatropic and Fries rearrangement.	9	CLO1, CLO2,
03	**Name reactions:** Clemmensen reduction, Aldol condensation,Cannizzaro reaction, Diels Alder, Friedel- Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Oppenauer oxidation, Perkin, Reimer-	9	CLO1, CLO2, CLO3,

	Tiemann, Witting and Wolf-Kishner reduction, Hofman degradation, Williamson Ether synthesis.		
04	**Heterocyclic Compounds:** General Introduction of Heterocyclic Compounds: Characteristic, properties and pharmaceutical importance of heterocyclic compounds: 5 membered (furan, thiophene, pyrrole, imidazole, Indole) 6 membered- (pyridine, piperidine, pyrimidine, Quinoline and isoquinoline)	7	CLO2, CLO3,
05	**Amino acids and proteins:** General considerations, structure of amino acids, acidity and basicity of amino acids, isoelectric point, preparations and reactions of amino acids, essential amino acids, metabolism of amino acids-deamination, transamination, racimization etc.	6	CLO1, CLO2,
06	**Synthesis and usages of some common drugs:**Paracetamol, aspirin, phenacetin, para-amino benzoic acid (PABA) and sulpha drugs.	5	CLO3

Text Book:

1. Advanced Organic Chemistry - Arun Bhal, B.S. Bahl.

Reference books:

1. Organic Chemistry (Vol. 1&2) - I.L. Finer.
2. Organic Chemistry - R.T. Morrison & R.N. Boyd.
3. Organic Chemistry - T.W. Graham Solomons.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	*Topic*	*Teaching-Learning Strategies*	*Assessment Strategies*
CLO1, CLO2	Stereochemistry	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO1, CLO2	Reaction mechanisms	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO1, CLO2,CLO3	Name reactions	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO2, CLO3,	Heterocyclic Compounds	Lecture, Online VDO, Discussion, Group	Class test (Short Q and MCQ)

		study for problem analysis	
CLO1, CLO2,	Amino acids and proteins	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO3	Synthesis and usages of some common drugs	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (05)**	**Presentation (10)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8			
Understand	4			
Apply	5			
Analyze				
Evaluate	3			
Create				

*Attendance 05

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	15
Apply	10
Analyze	10
Evaluate	
Create	

Course Code: PHARM 2105 Course Title: Biochemistry & Molecular Biology
Marks: 100 Credits: 03

Rationale: Understanding the structure and function of nucleic acid, source and function common molecular biology enzymes, the principles different molecular biology techniques i.e. DNA sequence techniques, southern, Northern & Western blotting, agarose gel electrophoresis, SDS-PAGE, PCR, RT-PCR etc.

Objectives:

- To familiarize him/herself with different approaches to central dogma of molecular biology.
- To gather knowledge about chemistry of nucleic acids and its function.
- To understand the chemistry, types, biosynthesis and functions of carbohydrates
- To gather knowledge about chemistry, types, biosynthesis and functions of lipids and protein.
- To understand the chemistry, classification, catalytic properties, mechanism of enzyme actions and function of different types of enzyme and co-enzymes.
- To know different techniques in molecular biology such as agarose gel electrophoresis, SDS-PAGE, PCR, RT-PCR etc.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Understand the structure isolation, purification, molecular weight determination of DNA, RNA and how their structure relates to their handling.
CLO2	Identify with the source and function of common molecular biology enzymes i.e. DNA polymerase, DNA ligase, reverse transcriptase, restriction enzymes, nucleases, exonucleases, endonucleases, proteases, RNase, and Dnase.
CLO3	Evaluate the chemistry, synthesis and function of various carbohydrates.
CLO4	Evaluate the chemistry, synthesis and function of various lipids.
CLO5	Compare the structure and classification of protein as well as the process of protein synthesis.
CLO6	Predict different types and functions of enzymes and coenzymes.
CLO7	Justify various theories of enzyme-substrate reaction increase the rate of biological reactions
CLO8	Explain the principle of amplification by polymerase chain reaction (PCR).
CLO9	Compare the principles of different molecular biology techniques i.e. DNA sequence techniques, southern, Northern & Western blotting, agarose gel electrophoresis, SDS-PAGE, RT-PCR etc.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	2	2			2				
CLO2	2	2			2				
CLO3	2	2			3	1			
CLO4	2	2			3	1			
CLO5	2	2			3				

CLO6	2	2			3				
CLO7	2	2			3				
CLO8	2	2			3				
CLO9	2	2			3				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SLNo.	Course Contents	Hrs	CLOs
01	**Nucleic acids:** Chemistry of nucleic acids, nucleoside bases, nucleotides, polynucleotides, nucleoproteins, RNA, DNA Structure, isolation, purification, molecular weight determination, chemical and enzymatic hydrolysis & hybridization.	5	CLO1
02	**Central dogma of molecular biology**: a) Replication; b) Transcription; c) Genetic code; d) Translation; e) Structure of protein, important domains and their function.	4	CLO2
03	**Carbohydrates:** The chemistry of carbohydrates, conversion of polysaccharides to glucose-1-phosphate, glycolysis and fermentation and their regulation, gluconeogenisis and glycogenolysis, metabolism of galactose and galactosemia, role of sugar nucleotides in biosynthesis and pentose phosphate pathways and other alternate pathway of carbohydrate metabolism,the citric acid cycle.		CLO3
04	**Lipids:** The chemistry of lipids, oxidation of fatty acids, biosynthesis of saturated and unsaturated fatty acids, essential fatty acids and eicosanoids (prostaglandins, thromboxane), phospholipids, and sphingolipids.		CLO4
05	**Proteins:** Definition, characteristics, chemical bonds, types and functions of protein. Amino acids and their classification, chemistry of aminoacids, synthesis of aminoacids, identification of aminoacid, peptide synthesis. Protein structure, denaturatation and renaturation of protein. protein separation and purification.		CLO5
06	**Enzymes and coenzymes:** Chemistry, classification, catalytic properties, enzyme specificity, mechanism of enzyme actions, enzyme catalyzed reactions, chemotherapy and enzyme inhibition. Coenzymes, thiamine pyrophosphate, flavin coenzyme, TH4, pantothenic acid, NAD+, NADH+, H+, pyridoxal pyrophosphate, biotin, vitamin B12.	4	CLO6 CLO7
07	**Techniques in molecular biology**: Polymerase chain reaction (PCR), DNA sequence techniques, southern, northern & western blotting, agarose gel electrophoresis, SDS-PAGE, RT-PCR, in	5	CLO8, CLO9

	vitro kinase assay, real time PCR, reverse transcriptase, alkaline lysis method to isolate DNA		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Nucleic acid	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Quiz, assignment
CLO2	Central dogma of molecular biology	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3	Carbohydrates	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	Lipids	Lecture, Question-Answer session	Class evaluation
CLO5	Proteins	Lecture, Question-Answer session	Class evaluation
CLO6 CLO7	Enzymes and coenzymes	Lecture, Question-Answer session	Class test
CLO8, CLO9	Techniques in molecular biology	Lecture, Online VDO, Discussion, Group study for problem analysis	Presentatiom

Text Books:

1. L. Lehninger: Principles of Biochemistry
2. Pamela C Champe, Harvey: Lippincott's Illustrated Reviews: Biochemistry

Reference books:

1. Jeremy M. Berg et al: Biochemistry
2. Satyanarayana : Biochemistry
3. Donald Voet, et al: Fundamentals of Biochemistry: Life at the Molecular Level

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (05)	Presentation (10)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	8			
Understand	5			
Apply	3			

Analyze	2			
Evaluate	2			
Create				

*Attendance 05

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	24
Understand	20
Apply	8
Analyze	4
Evaluate	4
Create	

Course Code: PHARM 2106 Course Title: Food and Nutraceuticals
Marks: 50 Credits: 02

Rationale: To acquire knowledge of nutraceuticals, functional foods and dietary supplements.

Course Objectives:

- To provide knowledge about foods, nutraceutical and herbal medicine.
- To impart knowledge effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipedimic herbs and nutraceuticals.
- To provide an understanding regarding method of food preservation, food irradiation, fermentation, processing of dairy foods, confectionary foods, cereals and grains, beverages, special infant foods and formulas, microorganisms in food, food packaging.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Define, distinguish and co-relate among different terms of foods, nutraceutical and herbal medicine.
CLO2	Understand the relationship of nutrition and health, dietary guidelines/food pyramid, food habit and obesity, effects of trans and omega 3,6,9 fatty acids on health and diseases.
CLO3	Summarize the effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipedimic herbs and nutraceuticals.

CLO4	Explain the method of food preservation, food irradiation, fermentation, processing of dairy foods, confectionary foods, cereals and grains, beverages, special infant foods and formulas, microorganisms in food, food packaging.
CLO5	Demonstrate the use of genetic engineering in improving plant and animal products and food processing.
CLO6	Predict the method of quality of nutraceuticals, dietary supplements & herbal products.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	2	2			2				
CLO2	2					1			
CLO3	2								
CLO4	2				2				
CLO5	2				2				
CLO6	2	2							

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Introduction:** Definition of functional foods, nutraceutical and herbal medicine, their role in health care management	5	CLO1
02	**Functional Foods:** Effect of processing of functional food on nutrients, effect of soy proteins and soy isoflavones in human health, role of dietary fibers in disease prevention, sources and role of isoprenoids, isoflavones, flavonoids, carotenoids, tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline, terpenoids, vegetables, cereals, milk and dairy products as functional foods, health effects of common beans, capsicum annum, mustards, ginseng, garlic, grape, citrus fruits, fish oils, and sea foods.	5	CLO1 ,CLO 2,
03	**Nutritional Requirements:** Balanced diet, factors affecting BMR and energy requirements for different activities, role of different nutrients in health and disease, nutritional requirements for different types of physical activities and sports, special needs before and after certain intensive and prolongedsports (Pre-game and Post-game meals), nutritional requirements of vulnerable sections such as infants, pregnant and lactating women, elderly and the dietary management, malnutrition: Occurrence,manifestation, prevention and therapeutic measures including fortification, formulation of diet and foods for specific needs.	6	CLO2
04	**Anti- nutritional Factors Present in Foods:** Types of inhibitors present in various foods and how they can be inactivated, general idea about role of probiotics and prebiotics as nutraceuticals, recent advances in techniques & feeding of substrates, assessment of nutritional status and recommended daily allowances.	3	CLO1 CLO2

05	**Food, nutrition, health and diseases:** Relationship of nutrition and health, dietary guidelines/food pyramid, food habit and obesity, effects of trans and omega 3,6,9 fatty acids on health and diseases	6	CLO2
06	**Nutraceuticals in herbal products, fruits, vegetables and grains with health benefits:** Effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipedimic herbs and nutraceuticals.	6	CLO3
07	**Food processing and food products developments:** Food preservation, food irradiation, fermentation, processing of dairy foods, confectionary foods, cereals and grains, beverages, special infant foods and formulas, microorganisms in food, food packaging	6	CLO4
08	**Food biotechnology:** Genetic engineering in improving plant and animal products and improving food processing.	4	CLO5
09	Herbal Products for Personal Care: Different ways of skin care and role of herbal products for skin care, skin disorders and herbal remedies, hair care and skin/scalp herbal remedies, herbal baths, aromatherapy.	4	CLO6

Text Book:

1. Jean-Richard Neeser et al : Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals.

References books:

1. Costas G. Biliaderis et al. : Functional Food Carbohydrates.
2. Fereidoon Shahidi : Nutraceutical and Specialty Lipids and their Co-Products.
3. Lisa Turner : A Nutraceutical Approach to Diet and Health.
4. W. Jeffrey Hurst: Methods of Analysis for Functional Foods and Nutraceuticals.
5. Robert E. C. Wildman : Handbook of Nutraceuticals and Functional Foods.
6. Fereidoon Shahidi et al : Nutraceutical Beverages: Chemistry, Nutrition, and Health Effects

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Introduction	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO1,CLO2,	Functional Foods	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), Presentation
CLO2	Nutritional Requirements	Lecture, Question-Answer session	Class test (Short Q and MCQ)

CLO1, CLO2	Anti- nutritional Factors Present in Foods	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO2	Food, nutrition, health and diseases	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), assignment
CLO3	Nutraceuticals in herbal products, fruits, vegetables and grains with health benefits	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO4	Food processing and food products developments	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO5	Food biotechnology	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), Presentation
CLO6	Herbal Products for Personal Care	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	
Understand	5	3	2	
Apply	2	4	1	
Analyze	2	2	1	
Evaluate	2	1		
Create	1			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 2107 Course title: Pharmacology-I- Lab
Marks: 50 Credits: 01

Rationale: Understanding the pharmacological effect of various types' drugs on experimental animals.

Objective:

- To provide practical knowledge and observe the effects of various types of drugs on biological system.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Gain practical knowledge and observe the effects of various types of CNS drugs on rats and toads
CLO2	Observe the effects of anesthetic agent and how they work on experimental animals.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			3					
CLO2	3	2			3					

(Level of correlation: 3-High, 2-Medium, 1-Low)

Course Contents:

SL No.	**SUMMARY OF COURSE CONTENT**	**Hrs**	**CLOs**
1.	Handling of experimental animals: mice and rat.	5	CLO1
2.	Different routes of administration of drugs in experimental animals.	5	CLO1
3.	Study of drugs acting on CNS **a)** CNS stimulant drugs (strychnine, ephedrine, amphetamine). **b)** CNS depressant drugs (barbiturates induced sleeping time).	5	CLO1
4.	Effect of pilocarpine on saliva secretion of rat.	5	CLO1
5.	Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.	4	CLO2
6.	Effect of local anesthetics on rats tail.	4	CLO1
7.	Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).	4	CLO2
8.	Diuretic effect of Furosemide. Study of the effects of diuretics and antidiuretics on the rate of urinary flow in animal (toad/ mice/ rats).	6	CLO2

Text Book:

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

Reference books:

1. H. P. Rang, M. M. Dale : Pharmacology
2. K. D. Tripathi : Essentials of Medical Pharmacology
3. R. A. Harvey, P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology
4. Andres Goth : Medical Pharmacology
5. B. G. Katzung : Basic and Clinical Pharmacology
6. R. S. Satoskar and Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	Handling of experimental animals: mice and rat.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Different routes of administration of drugs in experimental animals.	Written test, Quiz, Collecting data through observation and experimentation.
CLO1	Study of drugs acting on CNS a) CNS stimulant drugs (strychnine,ephedrine, amphetamine). b) CNS depressant drugs (barbiturates induced sleeping time).	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Effect of pilocarpine on saliva secretion of rat.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.	Written test, Quiz, Collecting data through observation and experimentation.
CLO1	Effect of local anesthetics on rats tail.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

CLO2	Study of the effects of diuretics and antidiuretics on the rate of urinary flow in animal (toad/ mice/ rats).	Written test, Quiz, Collecting data through observation and experimentation.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks)

Bloom's Category Marks (out of 15)	**Lab Performance Test (10)**	**Lab reports (05)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	1.5	2.5	
Understand	1	2.5	
Apply	1.5		
Analyze	1		
Evaluate	2.5		
Create	2.5		

*Lab Attendance 05

SEE- Semester End Examination (30 Marks)

Bloom's Category	**TEST (25)**	**Viva Voce (05)**
Remember	2.5	1
Understand	2.5	1
Apply	2.5	1
Analyze	2.5	1
Evaluate	7.5	1
Create	7.5	

Course Code: PHARM 2108 Course Title: Pharmaceutical Inorganic Chemistry- Lab
Marks: 100 Credits: 02

Rationale: This is a fundamental lab course in the Bachelor of Pharmacy program that provides the practical knowledge about preparation and identification of different inorganic drugs useful in pharmaceuticals.

Objectives:

- To make him/her able to identify inorganic ions used in pharmaceutical preparations.
- To know the methods of preparing topical agents, antacids containing inorganic materials.
- To gather knowledge of qualitative and quantitative analysis of inorganic preparations.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To utilize the knowledge of qualitative and quantitative analysis of Pharmaceutical Inorganic Chemistry in the related fields of Pharmacy.
CLO2	Identify various inorganic ions in pharmaceutical preparations.
CLO3	To learn how to prepare inorganic pharmaceuticals.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			2			1		
CLO2	3	3			2			1		
CLO3	3	3			3			2		

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL NO.	**Course Content**	**Hrs**	**CLOs**
1.	**Qualitative Analysis of Inorganic Ions and Radicals:** $Na^{+,}$ K^{+}, Ca^{+2}, Al^{+3}, Mg^{+2}, Fe^{+2}, Mn^{+}, Ag^{+}, Cu^{+} Cu^{+2}, Cl^{-}, Br^{-}, I^{-} and, CO_3^{-}, SO_4^{-2}, NO_3^{-}, PO_4^{-3} etc.	10	CLO1
2.	**Identification of Inorganic Ions from Pharmaceutical Formulations:** Ca^{+2}, Fe^{+2}, Al^{+3}, Mg^{+2}, K^{+} and Na^{+} ions from supplied preparations.	10	CLO2
3.	**Preparation of inorganic drugs:** a) Preparation of aluminium hydroxide gel. b) Preparation of magnesium hydroxide. c) Preparation of haematinics: ferrous chloride, ferrous gluconate and ferrous fumerate. d) Preparation of Boric acid, potash alum	12	CLO3

Text Book:

1. Bahl, A. and Bahl, B.S. 2015. A Textbook of Organic Chemistry. 22th Edition. S. Chand and Co. Ltd., New Delhi.
2. Morrison, R.T. and Boyd, R.N. 2010. Organic Chemistry. 7th edition. Pearson, India.
3. Clayden, J., Greeves N. and Warren, S. 2012. Organic Chemistry. 2nd edition, Oxford university press.
4. Smith J.G. Organic Chemistry. 3rd edition. University of Hawai'i at Ma-noa.

Reference books:

1. Practical Notebook of Organic Chemistry. National University, Bangladesh.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	Qualitative and quantitative analysis of inorganic ions in pharmaceutical preparations	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Identify various inorganic ions in pharmaceutical preparations.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Preparation of inorganic drugs and improve solubility of drugs	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests/viva-voce (20)	Lab reports (10)	Quizzes (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember			2	
Understand	4	3	2	
Apply	8	4	1	
Analyze	4	2		
Evaluate	2	1		
Create	2			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	10
Create	5

Course Code: PHARM 2109 Course Title: Pharmaceutical Organic Chemistry- Lab
Marks: 100 Credits: 02

Rationale: This is a fundamental lab course in the Bachelor of Pharmacy program that provides the practical knowledge to conduct qualitative analysis of organic compounds.

Objectives:

- To learn how to recognize different functional groups and elements in organic compounds.
- To determine purity, solubility, melting point and impurities of organic compounds.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Recognize the different functional groups from organic compounds.
CLO2	Apply the knowledge ofpurity, solubility and identification of organic compounds.
CLO3	Determine melting points of organic compounds.
CLO4	Apply different organic reactions to synthesize organic compounds.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3								
CLO2	3	3								
CLO3	3	3								
CLO4	2		3	1		3		3		

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	Identification of functional groups (OH^-, CHO, NH_2, NO_3, CO, CHO, COOH, etc)	4	CLO1
02	Detection of elements (C, H, N, O, F, Cl, Br etc)	4	CLO2
03	Test of purity	2	CLO2
04	Solubility test and classification of the compounds	2	CLO2
05	Identification of organic compounds: Solids and liquids, detection and identification of impurities, tests for carbohydrates, proteins and fats	4	CLO2
06	Melting point determination of different unknown organic compounds.	4	CLO3

07	Organic preparation involving typical reactions eg., Grignard reaction, Perkin reaction,Friedel craft reaction, esterification reaction.	4	CLO4

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	Identification of functional groups of organic compounds	Quiz, Collecting data through observation and experimentation, Written test.
CLO2, CLO3	Test of purity, melting point determination	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Organic reactions	experimentation and drawing conclusions of the experiments

Text Book:

1. Bahl, A. and Bahl, B.S. 2015. A Textbook of Organic Chemistry. 22th Edition. S. Chand and Co. Ltd., New Delhi.
2. Morrison, R.T. and Boyd, R.N. 2010. Organic Chemistry. 7th edition. Pearson, India.
3. Clayden, J., Greeves N. and Warren, S. 2012. Organic Chemistry. 2nd edition, Oxford university press.
4. Smith J.G. Organic Chemistry. 3rd edition. University of Hawai'i at Ma-noa.

Reference books:

1. Practical Notebook of Organic Chemistry. National University, Bangladesh.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	Tests (20)	Assignments (5)	Quizzes (10)	External Participation inCurricular/Co-Curricular Activities (0)
Remember	2		2	
Understand	5	2	4	
Apply	5	2	4	
Analyze	5	1		
Evaluate	3			
Create				

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	Marks
Remember	5
Understand	15
Apply	15
Analyze	15
Evaluate	10
Create	0

Course Code: PHARM 2201 Course Title: Pharmaceutical Analysis-I
Marks: 100 Credits: 03

Rationale: The rational of the course is to analysis any drug or medicine to make sure safety and security of patient**.**

Objectives:

- To make the students understanding of working principle of different types of classical techniques of drug analysis by following various aqueous and non-aqueous titrations.
- To help the students to understand on water analysis and potentiometric titrationwhich can be applied to quality control of drug substances.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Know the scopes of pharmaceutical analysis and demonstrate different terms in the field of pharmacy.
CLO2	Interpret theories and principles of different types of titrimetric method of drug analysis
CLO3	Measure moisture content in any drug or excipient.
CLO4	Analyze optically active substances by using polarimeter.
CLO5	Analyze drug or medicine by using potentiometer.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	2	2								
CLO2	2	2								
CLO3	2									
CLO4	2	2								
CLO5	2	3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Introduction to Pharmaceutical Analysis:** Significance of quantitative analysis in pharmaceutical quality assurance, different techniques of analysis, selection of samples, significant figures, Collection of data, tabulation and graphical representation of data, precision and accuracy of representative samples.	4	CLO1
02	**Titrimetric Analysis:** **a) Aqueous Acid-Base Titrations:** Definitions, distribution of acid base species with pH of the medium, acid-base titration for determination of acidic and basic pharmaceuticals. Indicators: theories, selection and applications. **b) Oxidation-Reduction Titrations:** Principles and concepts, determination involving potassium permanganate, potassium dicHouromate and potassium bromide. Iodimetric and iodometric determination, miscellaneous oxidation and reduction titrations, indicators and applications. **c) Complexometric Titrations:** Introduction, complexes and chelates, stability of complex ions, titrations based on complex formation,types of complexometric titrations, technique employed in chelometric titration, methods of end point detection, titration selectivity and masking reagents. **d) Non-aqueous Acid Base Titrations:** Theoretical considerations and principles of Bronsted-Lowry theory of acids and bases, non aqueous solvents, titration of weak acids and weak bases, applications and scope of non aqueous titration.	20	CLO2
03	**Aquametry**: Principle and scope, physical methods of water determination, chemical method of water determination, Karl-Fischer procedure–principle, chemistry, methodology, equipment, end point detection and limitation.	6	CLO3
04	**Polarimetry**: Introduction, instrumentation and application, optical isomerism, origin of optical rotation, molecular requirements for optical rotatory power, specific rotation, calculation of specific rotation, circular dichroism (CD), optical rotatory dispersion (ORD).	6	CLO4
05	**Potentiometric Titration**: Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, application of potentiometric titration.	6	CLO5

Text Books:

1. A Textbook of Pharmaceutical Analysis: Kennth A. Connors
2. A Textbook of Quantitative Inorganic Analysis, vol. I & II- Aurther I. Vogel

References books:

1. Pharmaceutical Chemistry, vol. 1 and 2: Lasie G. Chatten,
2. United State Pharmacopoeia

3. Quality Control in Pharmaceutical Industry: Murray S. Cooper
4. Pharmaceutical Analysis: David G. Watson.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Introduction to Pharmaceutical Analysis	Lecture, PPT Demonstration, Group discussion	Answer script evaluation, Class test, Quiz, assignment and presentation
CLO2	Titrimetric Analysis	Lecture, Online VDO, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment and presentation
CLO3	Aquametry	Lecture, Question-Answer session	Answer script evaluation, Class test, Quiz, assignment and presentation
CLO4	Polarimetry	Lecture, Online VDO, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment and presentation
CLO5	Potentiometric Titration	Lecture, Discussion, Group study for problem analysis	Answer script evaluation, Class test, Quiz, assignment and presentation

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 35)	Tests (20)	Assignments (10)	Presentation/ Quizzes (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	5			
Understand	5		3	
Apply	3	5	2	
Analyze	5	5		
Evaluate	2			
Create				

*Class Attendance: 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	20
Understand	20
Apply	5
Analyze	15
Evaluate	10
Create	

Course Code: PHAR 2202 Course Title: Physical pharmacy-II
Marks: 100 Credits: 03

Rationale: Understanding the physicochemical properties of matters, electrochemistry and application of phase rules.

Objectives:

- To provide knowledge about modern chemical kinetics and reaction rates
- To impart knowledge regarding rheology
- To provide an understanding regarding electrochemistry and electrochemical cells.

Course Learning Outcomes: at the end of the Course, the Student will be able to-

CLO1	To know about chemical kinetics and get idea about reaction rates
CLO2	To comprehend instability problems of drug products and understand stability testing protocols and regulatory requirements
CLO3	To define rheology and it's application and to learn techniques to determine particle size of drugs
CLO4	To differentiate among different types of interfaces and describe relevant examples in the pharmaceutical sciences
CLO5	Discuss the electrochemistry and electrochemical cells

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	3	3	3		2	1	3	3	1
CLO2	3			2	1	3	3	3	
CLO3	2	1			3	3	1	1	
CLO4	2		3						
CLO5	3		3					3	1

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Chemical Kinetics**: General consideration and concepts, rates and orders of reactions, methods for determination of orders of reactions, half life determination; factors affecting reaction rates -influence of temperature, humidity, light, solvent, catalytic species and other factors.	6	CLO1

02	**Drug Stability:** **Physical Degradation of Pharmaceutical Products**: Loss of water, absorption of water, loss of volatile constituents, polymorphism, color change. **Chemical Degradation**: Hydrolysis, oxidation, isomerization, polymerization, decarboxylation, factors affecting chemical degradation etc. **Stability of Pharmaceuticals:** Accelerated test for physical, chemical and photochemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination, expiration dating.	6	CLO2
03	**Surface and Interfacial Phenomenon:** Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, adsorption at solid and liquid interfaces, complex films, electrical properties of interface, electrical double layer, Nernst and zeta potential, Gibb's equation, spreading, characteristics of adsorption, application of adsorption in pharmacy. **Surface-active Agents:** Classifications of surfactants, emulgents, detergents and antifoaming agents, mechanism of actions and their uses in pharmacy.	6	CLO4
04	**Micrometrics and Powder Rheology:** Particle size and distribution, Importance of particle size determination, average particle size, number and weight distribution, particle number, method of determining particle volume- optical and electron microscope studies, coulter counter methods, laser beam technique, sieve analysis, sedimentation methods; particle shape, specific surface, determination of surface area, permeability, derived properties of powder, porosity, packing arrangements, density, bulkiness and flow properties.	5	CLO3
05	**Viscosity and Rheology:** Newtonian systems, Law of flows, basic equation of fluid flow, kinematics viscosity, effect of temperature, non-Newtonian system: pseudoplastic, dilatant and plastic flows, yield value, thixotropy, thixotropy in a formulation, determination of viscosity, measurement of flow and pressure and Reynolds number.	3	CLO3

06	**Electrochemistry:a)** Electrical units and their interrelation, Faradays laws of electrolysis and electrochemical equivalents, conductance of electrolytes, concept of E. M. F and its measurements, electrode, various types of electrochemical cells, relation between electrical and chemical energies, oxidation-reduction systems, solutions of electrolytes. **b)** Electrochemical cells and cell reactions, electrode and cell potentials, energies involved in electrode processes; reference electrodes, concentration cell, stoichiometry of electrolysis, electrochemistry and biological cell potentials.	4	CLO5

Text Book:

1. F.M. M. Haque and M. A. Nawab: Principles of Physical Chemistry

References books:

1. A. Martin and J. Swarbrick: Physical Pharmacy
2. Gordon M. Barrow : Physical Chemistry
3. C.V.S. Subrahmanyam: Textbook of Physical Pharmaceuticals
4. S. P. Agarwal and Rajesh Khanna: Physical Pharmacy
5. S. Glasstone and D. Lewis: Elements of Physical Chemistry
6. N. Kundu and S.K. Jain : Physical Chemistry
7. K. J. laidler: Chemical Kinetics

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Chemical Kinetics	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO2	Drug Stability	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO4	Surface and Interfacial Phenomenon	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO3	Micrometrics and Powder Rheology	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO3	Viscosity and Rheology	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), assignment
CLO5	Electrochemistry	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes/ Presentation (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	8		1	
Understand	5	3	2	
Apply	2	4	1	
Analyze	2	2	1	
Evaluate	2	1		
Create	1			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 2203 Course Title: Physiology and Anatomy-II
Marks: 100 Credits: 03

Rationale: To acquire the knowledge of human physiological and anatomical system.

Objectives:

1. To understand various system of human body.
2. To know about various disorders of various systems of human body.
3. To explore the possible mechanism of organ systems.
4. To identify possible mechanisms to solve and prevent common complications found in various organ system of human body.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Explain various system of the human body like nervous system, metabolism and excretory system.
CLO2	Comprehend the central concept of the endocrine system, encompassing the endocrine gland and their hormones, along with the anatomy and function of the reproductive organs.
CLO3	Compare the various disorder associated with various system of human body.
CLO4	Predict, solve and prevent common complications associated with various organ system of human body

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	**2**		**3**				**2**			**1**
CLO2	**2**		**3**				**2**			
CLO3	**2**		**3**		**2**	**2**	**2**			**1**
CLO4	**2**		**3**		**2**	**2**	**2**			**1**

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Content	Hrs	CLOs
01	**Nervous System:** **a)** Organization of nervous system. Neuron- properties, classification and functions; neuroglial cells and their functions; nerve fibers-definition, types, properties of nerve fibres, origin and propagation of nerve impulses across nerve fibers, action potential; synapse- classification, structure, properties and functions; neurotransmitters- classifications and functions, never endings. **b)** Reflex and reflex arc, their classifications, properties and components of reflex arc. **c)** Principal division of nervous system - CNS and PNS, functions of different parts of CNS, ascending and descending tracts of spinal cord, differences between - somatic & autonomic, and sympathetic & parasympathetic nervous system; cranial and spinal nerves & their functions, structure and function of brain.	10	CLO1, CLO3
02	**Excretory System:** Structure and function of kidney, composition and formation of urine, renal circulation, renal regulation of acid base balance, renal diseases and kidney function tests, physiology of micturition, artificial kidney: basic principles, method and applications.	6	CLO1, CLO3
03	**Metabolism:** Fat, carbohydrate, protein and nucleoprotein metabolism; metabolic pathways of fats, carbohydrates and proteins; enzymes, vitamins and hormones regulating various metabolic steps.	8	CLO2, CLO3
04	**Endocrine System:** Introduction to different endocrine glands. **a)** Pituitary glands: anterior and posterior pituitary glands, its function and disorders. **b)** Thyroid glands: Structure, synthesis of hormone, control of secretion and their function, disorder to thyroid gland, thyroid function test. **c)** Parathyroid gland: organization, secretion and function of hormone, Ca^{+2} metabolism, and tetany. **d)** Adrenal cortex: structure, biosynthesis of steroid hormones and their function, regulation of hormone secretion, disorder of adrenal cortex. **e)** Adrenal medulla: Structure, biosynthesis of hormone, their function and regulation, disorder of adrenal medulla. **f)** Islets of Langerhans of pancreas: function, secretion, and diabetes mellitus.	10	CLO1, CLO4
05	**Reproductive System:** Testis & accessory reproductive systems & their functions, male hormones and their functions, spermatogenesis and its hormonal regulation. Organs of female reproductive system and their functions, menstruation cycle, different phases & its regulation; ovogenesis &	8	CLO1, CLO2, CLO3

	ovulation and its control; female sex hormones & their functions; pregnancy and lactation & their hormonal control.		

Text books:

1. W. F. Ganong: Review of Medical Physiology
2. Guyton: A Textbook of Medical Physiology

References books:

1. C.C. Chatterjee: Human Physiology Vol. I & II
2. Shahan et al.: Human Physiology
3. S. Wright: Applied Physiology
4. Selim Reza: The Essentials of Human Physiology
5. Lehninger et al: Principles of Biochemistry
6. A.C. Dev: Fundamental of Biochemistry

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1, CLO3, CLO4	Nervous system	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), Quiz, assignment
CLO1, CLO3	Endocrine system	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), Quiz, assignment
CLO1, CLO3	Reproductive system	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), Presentation
CLO2, CLO3	Metabolism	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO1, CLO4	Excretory system	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes/ Presentation (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	10		1	
Understand	6	3	2	
Apply	2	4	1	
Analyze		2	1	
Evaluate	2	1		
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 2204 Course Title: Hospital and Community Pharmacy
Marks: 100 Credits: 03

Rationale: To acquire knowledge about patient care in hospital and community clinic.

Objectives:

- To provide basic concept about functional and structural principles of hospital and community pharmacy.
- To provide working knowledge on in-patient and out-patient drug dispensing.
- To impart knowledge on controlled substance and how to handle them systematically.
- To familiarize with the available hospital and community health services of Bangladesh.
- To promote rational use of drugs by providing necessary knowledge.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To understand the structural and operational system of the hospital and community pharmacy.
CLO2	To familiarize with the clinical practice in hospitals.
CLO3	To learn about the concept of controlled handling of narcotics and other restricted drugs.
CLO4	To understand in-patient and out-patient health care delivery systems.
CLO5	To achieve knowledge regarding hospital and community health care services in Bangladesh.
CLO6	To conceptualize the necessity for rational use of drug as well as the contributing factors towards irrationality.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2		1		3		1	1	2
CLO2	2	2		1		3			3	3

(Level of correlation: 3-High, 2-Medium, 1-Low)

CLO3	2	2				2			3	2
CLO4	2	3	2			2			2	2
CLO5	2	1	1			2			1	2
CLO6	2	2							3	3

SL No	Course Content	Hrs	CLOs
01	**Introduction to Hospital Pharmacy:** Goals, minimum standards, abilities required for a hospital pharmacist, hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital, hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job description.	5	CLO1
02	**Pharmacy and Therapeutics Committee:** Description and purpose, membership and functions, hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text, investigational use of drugs, description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.	5	CLO1, CLO2
03	**Control of Special Classes of Drugs**: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols, narcotics and their control, classes, procurement and execution of order forms, dispensing, hospital narcotic regulations, new systems, floor stock drugs, selection, charge and non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.	6	CLO2, CLO3
04	**Dispensing to In- and Out-patients:** Drug distribution systems, dispensing of charge, non-floor stock drugs, mobile dispensing unit, unit dose dispensing, new concepts, dispensing to out-patients, locality of out-patient dispensing area, dispensing routine, record keeping, dispensing during off-Hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call, drug charges in hospitals, pricing, break-even point pricing.	6	CLO2, CLO4

05	**Community Pharmacy:** Concept of community health care, health needs of the community, different level of health care, elements of primary health care, principles of primary health care: equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies. Community Pharmacy Concept in Bangladesh and its significance.	6	CLO5
06	**Rational Use of Drugs:** Background of rational use of drugs, definition, factors underlying irrational use of drugs: patients, prescribers, drug supply system; drug regulation and drug promotion, impact of irrational use of drugs with examples, disease-specific indicators, drug use patterns in developing countries, changing drug use patterns, factors effecting drug use, strategies to improve prescribing, experiences with interventions to change drug use in developing countries, strengths and weaknesses of different interventions to change drug use patterns, international network for rational use of drugs.	6	CLO6

Text Book:

1. William E. Hasan: Hospital Pharmacy

References books:

1. Parthasarathi et al: A Textbook of Clinical Pharmacy Practice
2. Stone et al: Pharmacy Practice

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	**Introduction to Hospital Pharmacy, Pharmacy and Therapeutics Committee**	Lecture, Question-Answer session, PPT Demonstration	Class test (Short Q and MCQ) assignment
CLO2	**Pharmacy and Therapeutics Committee, Control of Special Classes of Drugs, Dispensing to In- and Out-patients**	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment

CLO3	**Control of Special Classes of Drugs**	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	**Dispensing to In- and Out-patients**	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ)
CLO5	**Community Pharmacy**	Lecture, Question-Answer session	Class test (Short Q and MCQ) Presentation
CLO6	**Rational Use of Drugs**	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes/ Presentation (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	4	2	2	
Apply	5	2	4	
Analyze	4			
Evaluate	3			
Create		1	2	

***Class Attendance: 05**

Semester Final Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	5

Course Code: PHARM 2205 Course Title: Biostatistics
Marks: 50 Credits: 02

Rationale: To acquire the basic knowledge of Biostatistics and its application in pharmacy fields.

Objectives:

- To apply knowledge of statistics in pharmacy.
- To understand how to use statistical tools and techniques to solve biological problems.

Course Learning Outcomes (CLOs): at the end of the Course, the Student will be able to-

CLO1	To know the application of the statistics in the field of pharmacy.
CLO2	Discuss the descriptive statistics and applications of statistical ideas, tools and techniques in biological problem
CLO3	Develop problem solving techniques needed to accurately calculate probabilities.
CLO4	Implement the fundament of hypothesis and draw conclusions about hypotheses from the results of different statistical tests.
CLO5	Utilize the method and concept of simple and multiple correlations and regression analysis.
CLO6	Analyze and interpret the biological data using SPSS and GraphPad Prism

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2								
CLO2	2	2								
CLO3	2	2								
CLO4	2	3			2					
CLO5										
CLO6										

(Level of correlation: 3-High, 2-Medium, 1-Low)

SLNo.	**Course Contents**	**Hrs**	**CLOs**
01	**Introduction to statistics:** Definition, scope and application of statistics in Pharmacy, collection and presentation of data, arithmetic mean, geometric mean, harmonic mean, weighted mean, median and mode, equation of straight lines; determination of slope and intercept, graphs and diagrams	4	CLO1
02	**Measures of dispersion:** Range, mean deviation, standard deviation, variation, coefficient of variation, standard deviation; moments, skewness, and kurtosis	4	CLO2

03	**Basic concept of probability and probability distribution:** The normal, binominal and Poisson distribution, derivation, means and variances.	2	CLO4
04	**The correlation and regression analysis of measurement:** General concept of correlation and regression, calculation of correlation coefficient; basic idea of regression, calculation of regression coefficient.	2	CLO5
05	**Tests of Hypothesis:** Basic concepts of tests of significance, tests of means and variances based on normal, t, χ^2 and F distributions, tests of independence in a contingency table.	4	CLO3
06	SPSS and GraphPad Prism	4	CLO6

Text Books:

1. Anderson, A.J.B (1989): Interpreting Data, Chapman and Hall, London.
2. Cramer, H. (1955): The Elements of Probability Theory, Wiley, N. Y.
3. Gupta, S.C. and Kapoor, V.K.(1.001): Fundamentals of Applied Statistics, 3rd Ed. Sultan Chand and Sons, N-Delhi, India.

References books:

1. Hoel, P.G. (1993): Introductory Statistics, Wiley, N.Y. / Lipschutz, S. (1987): Probability, McGraw-Hill, N.Y.
2. Mosteller, F., Rourke and Thomas (197(1): Probability with Statistical Applications, 2nd Ed., Addison-Wesley, N. Y.
3. Ross, S.M. (2002): Introduction to Probability Models. 3rd 4 Academic Press, N.Y.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	2		2	
Understand	5	2	4	
Apply	5	2	4	
Analyze	4	1		
Evaluate	2			
Create	2			

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	Marks
Remember	10
Understand	15
Apply	15
Analyze	15
Evaluate	5

Course Code: PHARM 2206 Course Title: Biochemistry and Molecular Biology- Lab
Marks: 50 Credits: 01

Rationale: Designed to help students to develop skills to estimate the DNA, RNA and the concentration of protein, and to perform various biochemical test of kidney and liver.

Objectives:

- To provide sufficient practical knowledge to determine protein content in an unknown sample.
- To provide technical knowledge on various techniques like UV-spectroscopy, SDS-PAGE etc.
- To enable the students to perform kidney and liver function test.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	1	3			2		1			
CLO2	1	3			2					
CLO3	1	3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

Course Learning Outcomes (CLOs): at the end of this course, students will be able to

CLO1	Utilize the practical knowledge of genetics and molecular biology to quantify protein in an unknown sample.
CLO2	Conceptualize the working principles of techniques like UV-spectroscopy, SDS-PAGE etc.
CLO3	Perform various biochemical tests (liver function tests, kidney function tests) in academic, medical or industrial research environment.

SL No.	Course contents	Hrs	CLOs
01	Determination of protein content and extinction coefficient of protein by spectrophotometric method	2	CLO1 CLO2
02	Estimation of RNA/DNA by UV Spectroscopy.	2	CLO2
03	Identification and molecular weight determination of protein by SDS-PAGE.	3	CLO2
04	Kidney Function test: Determination of serum creatinine level, Determination of blood urea level.	3	CLO3
05	Liver Function test: Determination of SGPT, SGOT levels in blood.	3	CLO3

Text Books:

1. The Cell: A molecular Approach: Alberts B et al
2. Applied therapeutics: Young kode kihble et.al.
3. Hand book of Drug Interaction: Karalliedde & Hanry

References books:

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	White board and Lab experiments.	Quiz exam, Collecting data through observation and experimentation, oral evaluation,
CLO2	White board and Lab experiments.	Quiz exam, Collecting data through observation and experimentation, oral evaluation,
CLO3	White board and Lab experiments.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (15 out of 20)	Tests (10)	Lab note preparation (5)	External Participation inCurricular/Co-Curricular Activities (0)
Remember	2	1	
Understand	2	2	
Apply	3	1	
Analyze	2		
Evaluate	1		
Create		1	

*Class Attendance: 05

Semester Final Examination (30 Marks)

Bloom's Category	Marks
Remember	5
Understand	5
Apply	8
Analyze	7
Evaluate	3
Create	2

Course Code: PHARM 2207Course Title: Physiology and Anatomy-Lab
Marks : 100 Credits: 02

Rationale: To explore the practical knowledge about various physiological parameters of human body.

Objectives:

1. To make the students enable to determine various physiological parameters that will eventually promote them to find out the potential side effects of drug in animal model.
2. To make the student skillful on the physiological parameters so that they can use these tools during drug discovery and development.

Course Learning Outcomes (CLOs): At the end of this course, students will be able to-

CLO1	Determine blood pressure and effects of posture on it.
CLO2	Total and differential count of blood.
CLO3	Determine bleeding and clotting time.
CLO4	Grouping of blood
CLO5	Estimate hemoglobin content
CLO6	Heartbeat of mice and effects of electrolytes on it
CLO7	Estimate ESR, PCV and separate plasma.
CLO8	Determine blood sugar

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2									
CLO2	2									
CLO3	3									
CLO4	3									
CLO5	3									
CLO6	3									

CLO7	3									
CLO8	3									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	Measurement of blood pressure.	3	CLO1
02	Effect of different posture on blood pressure	3	
03	Total count of R.B.C.	5	CLO2
04	Total count of W.B.C.	5	
05	Differential count of W.B.C.	5	
06	Determination of clotting time.	3	CLO3
07	Determination of bleeding time.	3	
08	Determination of blood group.	4	CLO4
09	Estimation of hemoglobin.	4	CLO5
10	Recording of normal heart beat in mice	3	CLO6
11	Demonstration of the effect of Electrolytes (Na^+, K^+, Ca^+) on mice heart.	6	
12	Determination of ESR (Erythrocyte Sedimentation Rate).	4	ClO7
13	Determination of Packed Cell Volume (PCV).	4	
14	Separation of plasma from human blood	2	
15	Determination of blood sugar level at fasting condition and after 2 hours of meal	2	CLO8

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Measurement of blood pressure.	Teaching-Learning Strategies	Assessment Strategies
CLO1	Effect of different posture on blood pressure	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO2	Total count of R.B.C.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO2	Total count of W.B.C.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO2	Differential count of W.B.C.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO3	Determination of clotting time.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation

CLO3	Determination of bleeding time.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO4	Determination of blood group.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO5	Estimation of hemoglobin.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO6	Recording of normal heart beat in mice	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO6	Demonstration of the effect of Electrolytes (Na^+, K^+, Ca^+) on mice heart.	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO7	Determination of ESR (Erythrocyte Sedimentation Rate).	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO7	Determination of Packed Cell Volume (PCV).	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO7	Separation of plasma from human blood	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation
CLO8	Determination of blood sugar level at fasting condition and after 2 hours of meal	Lecture, Group discussion, Lab experiment	Lab performance test, Quiz, Viva, Lab result evaluation

Textbooks:

1. Textbook of Practical Physiology: G.K. Pal

References books:

1. Ross & Wilson Anatomy and Physiology in Health and Illness, 13th Edition.
2. Clinical Anatomy: Applied Anatomy for Students and Junior Doctors, 14th Edition.
3. Mader's Understanding Human Anatomy & Physiology, 8th Edition.
4. Practical Human Anatomy and Physiology: SR Kale, RR Kale.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 30)	Lab performance Test (20)	Lab reports (10 marks)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	3		
Understand	3		

Apply	3		
Analyze	3		
Evaluate	4		
Create	4		

Lab Attendance: 10

SEE- Semester End Examination (60 marks):

Bloom's Category	**Test (50)**	**Viva Voce (10)**
Remember	5	3
Understand	5	3
Apply	5	2
Analyze	5	2
Evaluate	10	
Create	20	

Course Code: PHAR 2208 Course Title: Physical Pharmacy-Lab
Marks: 100 Credits: 02

Rationale: To provide practical knowledge of preparation of primary and secondary standard solutions and standardization of the solution.

Objectives:

- To provide knowledge about preparation of the primary and secondary standard solutions
- To impart knowledge regarding density measurement of a liquid / solution by density bottle / pycnometer method

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Prepare the primary and secondary standard solutions.
CLO2	Standardize the primary and secondary standard solutions.
CLO3	Determine pKa and pKb values, phase diagram of binary systems, distribution coefficients, heat of solution by measuring solubility as a function of temperature.
CLO4	Determine the phase diagram of binary systems, distribution coefficients, heat of solution by measuring solubility as a function of temperature.
CLO5	Measure the density of a liquid / solution by density bottle / pycnometer method
CLO6	Compare the viscosity of pure liquids as well as liquid pharmaceutical preparation-syrup, emulsion, suspension etc.
CLO7	Analyze the equilibrium constant of the reaction.
CLO8	Determine the solubility of a sparingly soluble salt in water.

CLO9	Determine the molecular weight of an organic solid.

Mapping of Course Learning outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2								
CLO2	3	2								
CLO3	1	2								
CLO4	2									
CLO5	1	2								
CLO6	2									

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
1.	Standardization of acids and bases	2	CLO1
2.	Determination of pKa and pK_b values.	2	CLO2
3.	Preparation of solution of different pH & buffer capacity.	2	CLO3
4.	Determination of phase diagram of binary systems.	4	CLO3
5.	Determination of distribution coefficients.	6	CLO3
6.	Determination of mol. Wt. by Victor Meyer's method.	4	CLO3
7	Determination of heat of solution by measuring solubility as a function of temperature.	4	CLO4
8.	Viscosity determinations: **a)** Determination of viscosity of pure liquids such as glycerin, alcohol etc. **b)** Determination of viscosity of liquid pharmaceutical preparation- syrup, emulsion, suspension etc. **c)** Study of variation of viscosity of liquid with temperature using Ostwald or Engleris viscometer.	2	CLO4
9.	Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/ NaOH.	2	CLO6
10.	Determination of adsorption isotherm of oxalic (or acetic) acid form aqueous solution by charcoal and calculation of the constant in Freundlich's equation.	2	CLO5
11.	Determination of the equilibrium constant of the reaction KI + I = KI_3.	2	CLO7
12.	Determination of solubility of a sparingly soluble salt in water by conductance measurement.	2	CLO8
13.	Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurements.	2	CLO9
14.	Determination of the molecular weight of an organic solid	2	CLO10

Text Book:

1. Practical Physical Chemistry: Sharma, Vikas Publishing House Pvt. Ltd.

References books:

1. Practical Physical Chemistry: Palit, Science Book Agency, Calcutta.
2. Advanced Practical Physical Chemistry: J. B. Yadav
3. Text Book of Practical Chemistry: Khalique, A, Ideal Library, Bangla Bazar, Dhaka
4. Practical Chemistry: O.P. Pandey, D.N. Bajpai, and S. Giri, S. Chand & Co. Ltd, New Delhi.
5. Practical Physical Chemistry: A. Findlay, Longmans, Green and Company Ltd.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Standardization of acids and bases	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Determination of pKa and pK_b values.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Preparation of solution of different pH & buffer capacity.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO3	Determination of phase diagram of binary systems.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO3	Determination of distribution coefficients.	Written test, Quiz, Collecting data through observation and experimentation.
CLO3	Determination of mol. Wt. by Victor Meyer's method.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Determination of heat of solution by measuring solubility as a function of temperature.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO4	Viscosity determinations.	Written test, Quiz, Collecting data through observation and experimentation.
CLO6	Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/ NaOH.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

CLO5	Determination of adsorption isotherm of oxalic (or acetic) acid form aqueous solution by charcoal and calculation of the constant in Freundlich's equation.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO7	Determination of the equilibrium constant of the reaction KI + I = KI_3.	Written test, Quiz, Collecting data through observation and experimentation.
CLO8	Determination of solubility of a sparingly soluble salt in water by conductance measurement.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO9	Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurements.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO10	Determination of the molecular weight of an organic solid	Written test, Quiz, Collecting data through observation and experimentation.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 30)	**Lab Performance Test (20)**	**Lab Report (10)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	5	5	
Understand	5	5	
Apply	2		
Analyze	3		
Evaluate	2		
Create	3		

Lab Attendance: 10

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (50)**	**Viva Voce (10)**
Remember	10	3
Understand	10	3
Apply	5	2
Analyze	5	2
Evaluate	10	
Create	10	

Course Code: PHARM 2209 Course Title: Viva voce-II
Marks: 50 Credits: 01

Rationale: The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board.

Objective: This course gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Learn how to approach themselves before an interview board.
CLO2	Overcome the fear or nervousness of facing face to face interview or interaction.
CLO3	Present their concepts systematically in oral form.
CLO4	Prepare them for future job interview.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3								2	
CLO2	3								2	
CLO3	3									
CLO4									3	

SL NO	**Course content**	**Hrs**	**CLOs**
1.	Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire second year including semester I and semester II.	-	CLO1 CLO2 CLO3 CLO4

Text Book:

2. All books relevant to courses studied during second year first and second semester.

Reference books:

3. Marc Dorio. Complete Idiot's Guide to the Perfect Interview. 2nd edition, 2000; Alpha Books.
4. Susan Hodgson. Brilliant Answers to Tough Interview Questions. 5th edition, 2015; FT Press

Course Code: PHARM 3101 Course Title: Pharmaceutical Analysis-II
Marks: 100 Credits: 03

Rationale: To study recent trends in analytical science and techniques and be introduced to pharmaceutical technologies.

Objectives:

- To understand the importance of analysis in pharmaceutical industry.
- To understand the knowledge about assay of pharmaceutical substance and product.
- To develop basic practical skills using instrumental techniques.
- To inculcate theoretical knowledge on various instrumental techniques adopted for analysis of pharmaceuticals.
- To develop various methodologies for assay of drugs and pharmaceuticals with the skills and knowledge gained.
- To understand and gain knowledge on trouble shooting in adopting various methodologies using instrumental techniques.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Interpret theories and principles of different types of chromatographic techniques.
CLO2	Understand the theories and principles of some modern analytical techniques.
CLO3	Explain applications and importance of different types of pharmaceutical analysis.
CLO4	Interpret the theories and principles of different types of spectroscopic methods for the identification of organic compounds.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	1			1					
CLO2	2	1			1					
CLO3	2	1			1					
CLO4	2	1			1					

(Level of correlation: 3-High, 2-Medium, 1-Low

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	Chromatographic Methods: a) Introduction, principles, preparation, procedure, method of detection, classification, and applications of chromatography. b) Gel filtration chromatography. c) Thin layer chromatography. d) Affinity chromatography. e) Ion exchange chromatography.	10	CLO 1
02	Spectroscopic techniques: a) Visible and Ultraviolet Spectrophotometry: Introduction, electromagnetic radiation, units, electromagnetic spectra and	10	CLO 3

	absorption of radiation, Lambert's and Beer's law, deviations from Lambert-Beer law, instrumentation, chromophores and auxochromes, applications of ultraviolet and visible spectroscopy in quantitative analysis of drugs. b) Fluorometry: Introduction, principle, fluorescence and chemical structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and uv-visible spectrophotometry, applications of fluorometry in pharmaceutical analysis. c) Atomic Absorption Spectroscopy: Theory, instrumentation and application in quantitative analysis.		
03	Polarography and Amperometric Titration: Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.	6	CLO 2
04	Mass Spectrometry: Introduction, basic principle, brief outline of instrumentation, ion formation and types, fragmentation process, fragmentation patterns, fragmentation characteristics in relation to parent structure and functional groups.	8	CLO 3, CLO 4
05	X-ray Crystallography: Generation and properties of X-ray, diffraction of X-ray by crystals, Bragg's equation, X-ray diffraction methods, powder diffraction patterns, methods of measurement, analysis, application of X-ray diffraction.	8	CLO 2, CLO 3

Text Book:

1. Gurdeep R. Chatwal et al. : Instrumental Methods of Chemical Analysis

References books:

1. A.H. Beckett, et al: Practical Pharmaceutical Chemistry Vol. I & II
2. K. A. Connors : A Textbook of Pharmaceutical Analysis
3. L.G. Chatten: Pharmaceutical Chemistry Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Chromatographic Methods	Lecture, Group study for problem analysis	Class test (Short Q and MCQ) Assignment
CLO2	Polarography and Amperometric Titration, X-ray Crystallography	Lecture, Group study for problem analysis	Class test (Short Q and MCQ) Assignment
CLO3	Spectroscopic techniques, Mass Spectrometry, X-ray Crystallography	Lecture, Group study for problem analysis	Class test (Short Q and MCQ)
CLO4	Formulation of Marketing Strategies and New Product	Lecture, Group study for problem analysis	Class test (Short Q and MCQ)

	Launches, Mass Spectrometry		

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (20 out of 28)	**Tests (20)**	**Assignments (10)**	**Quiz/Presentation (5)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	6	4	2	
Apply	6	4	1	
Analyze	2	2		
Evaluate	2			
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks)

Bloom's Category	**TEST (60)**
Remember	20
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	5

Course Code: PHARM 3102 Course Title: Pharmacology-II

Full Marks: 100 Credits: 03

Rationale: Understanding the mechanism of actions of different classes of drugs. The course will cover the knowledge of pharmacologic principles and their application regarding the use of different classes of drugs.

Objectives:

- To educate students on autacoids elaborately.
- To provide lessons on analgesic, antipyretic and anti-inflammatory drugs, Haematopoietic System and Drug acting on CNS and ANS.
- To theoretically, gain knowledge on Chemotherapy of Parasites.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To know about variousautacoids, their mechanism of action, indication, contraindication, their dose and available market products.
CLO2	To acquire knowledge about various types of analgesic, antipyretic and ant- inflammatory drugs and Drug acting on CNS and ANS.
CLO3	To gain concept about various Chemotherapeutic agents for parasites, their mechanism of action, indication, contraindication, their dose and available market products.
CLO4	To accumulate concept on Drugs Used in Haematopoietic System and its mode of action.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			2	3				
CLO2	3	2			2	3				
CLO3	3	2			2	2				
CLO4	3	2			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Autacoids:** **a)** Histamines: Mode of action, anaphylactic shock, histamine-releasing drugs, allergic disorder. **b)** Antihistamines: Classification, pharmacological, therapeutic uses, adverse reactions, etc. **c)** Serotonin and serotonin antagonists, prostaglandins, prostacyclins and thromboxane. **d)** The kinins: Kallidins and bradykinin.	8	**CLO1**
02	**Analgesic, Antipyretic and Anti-inflammatory drugs:** **a)** Non-narcotic analgesic **b)** Narcotic analgesics	4	**CLO2**
03	**Drugs Used in Haematopoietic System:** (a)Anticoagulants: Heparin, calcium complexing agents, oral anticoagulants. (b) Haematinic drugs: Iron, vit B12, folic acid, Erythropoietin	8	**CLO4**
04	**Chemotherapy of Parasites:** Drugs used in helminthiasis, malaria, amebiasis.	6	**CLO3**
05	**Drugs affecting Central Nervous System** **a)Psychotropic and Antidepressant Drugs:** Classification, mode of action, pharmacological actions, indications, toxicities and contraindications of different drug classes. **b)Anxiolytic and Hypnotic Drugs** **c)CNS Stimulants** **d)Antiepileptic Drugs:** types of seizures, classification, mode of action, pharmacological actions, indications, adverse reactions of different drugs	8	**CLO2**

06	**Drug Acting on ANS** **a)** (i) Parasympathomimetic agents: Acetyl choline, Methacoline, Carbachol. (ii) Sympath-omimetic drugs: Epinephrine, norepinephrine. (iii) Anticholinesterase agents: Physostignine, Edrophonine. **b)** (i) Antimuscarinic Agents or Atropine Drugs (ii) Drugs inhibiting adrenergic nerves, adrenergic blocking agents. **c)** Ganglion Stimulating and Blocking Agents.	8	**CLO2**

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Autacoids	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO2	Analgesic, Antipyretic and Anti-inflammatory drugs	White board, PPT presentation, self-study of relevant materials.	Quiz, written test and self-generated question solution.
CLO3	Chemotherapy of Parasites	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ), assignment
CLO3	Drugs affecting Central Nervous System	White board, PPT presentation, self-study and case study.	Quiz, written test and problem identification & solution.
CLO3	Drug Acting on ANS	White board, PPT presentation, self-study and case study.	Class test (Short Q and MCQ), assignment
CLO4	Drugs Used in Haematopoietic System	White board, PPT presentation, self-study and case study.	Class test (Short Q and MCQ), assignment

Text Books:

1. H. P. Rang, M. M. Dale, J. M. Ritter: Pharmacology
2. Goodman Gilman and P. Taylor: Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

References books:

1. H. P. Rang, M. M. Dale, J. M. Ritter: Pharmacology
2. K. D. Tripathi: Essentials of Medical Pharmacology
3. R. A. Harvey and P. C. Champe: Lipponcott's Illustrated Reviews Pharmacology
4. Andres Goth: Medical Pharmacology
5. B. G. Katzung: Basic and Clinical Pharmacology

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes /Presentation (5)	Class Attendance (5)
Remember	40			
Understand	15			
Apply	3			
Analyze	2			
Evaluate				
Create				

SFE- Semester Final Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	30
Understand	20
Apply	5
Analyze	5
Evaluate	
Create	

Course Code: PHARM 3103 Course Title: Medicinal Chemistry-I
Marks: 100 Credits: 03

Rationale: The intent of the course is to build upon basic understanding of working principle of different types of classical techniques of drug analysis which can be applied to quality control of drug substances.

Objectives:

- To understand the basic principles of medicinal chemistry in pharmacy
- To gather knowledge about drug discovery and design
- To gather knowledge about various types of drug targets, identification and validation
- To familiarize him/herself with chemistry, SAR, mode of action and synthesis of some common essentials drugs.
- To understand geometric isomerism and conformational isomers, asymmetric synthesis, stereoselective and stereospecific reaction, pharmaceutical importance of stereochemistry.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To utilize the knowledge of medicinal chemistry in drug discovery and design
CLO2	To explain the stereochemistry of medicinal compounds and its importance in designing drugs
CLO3	Understand the different types of drug targets and their role in drug design.
CLO4	Know the chemistry and structural activity relationship of different classes of drugs.
CLO5	Explain about different types of methods for synthesizing medicinal components.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	1			1		1			
CLO2	2	1			1					
CLO3	2	1			1		1			
CLO4	2	1			1		1			
CLO5	2	1			1					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Introduction:** Basic principles and scope of medicinal chemistry in pharmacy, Influence of physicochemical properties of drugs on its biological action.	5	CLO1 CLO2
02	**Stereochemistry:** A general concept of different types of isomerism, Geometric isomerism of alkenes and cyclic compounds, cis, trans and (E), (Z) systems of nomenclature. Conformational isomers- conformation of open chain and cyclic compounds. Chirality of molecules- enantiomer, diastereomer, racemic modification, meso compound, (R) and (S) configuration, sequence rule, optical rotation. Asymmetric synthesis- preparation of enantiomer by asymmetric synthesis and optical resolution method. Stereoselective and stereospecific reaction. Pharmaceutical importance of stereochemistry	10	CLO2
02	**Drug targets:** various types of drug targets; identification and validation Protein structure and drug design.	10	CLO3

	Receptors as drug targets: General principles of designing and developing various receptor agonists and antagonists. Receptors sensitization and desensitization, tolerance and dependence. Enzymes as drug targets: designing enzyme inhibitors Nucleic acids as drug targets. Signal transduction and its role in designing drugs		
03	**Chemistry, SAR, Mode of Action and Synthesis of the Following Groups of Drugs:** Sedatives & Hypnotic agents: Benzodiazepines, Barbiturates. Antihistamines: H_1 and H_2 antagonists. Analgesic: NSAIDs (Indomethacin, Ibupropen, Naproxen, Phenacetin, Phenylbutazone, Mefenamic Acid), Opioid analgesic. Cardiovascular Drugs: Hydralazine , Propranolol, Prenylamine. Diuretics: Chlorothiazide , Acetazolamide , Triamterene.	17	CLO4, CLO5

Text Books:

1. Graham L. Patrick: Cooper and Gunn's Dispensing for Pharmaceutical Students
2. Wilson and Gisvold: Textbook of Organic, Medicinal and Pharmaceutical Chemistry

References books:

1. Ashutosh Kar: Medicinal Chemistry
2. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1 CLO2	Introduction	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO2	Stereochemistry	White board, PPT presentation, self-study of relevant materials.	Quiz, Class test and self-generated question solution.
CLO3	Drug Targets	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ), assignment
CLO4, CLO5	Chemistry, SAR, Mode of Action and Synthesis of Drugs	White board, PPT presentation, self-study and case study.	Quiz, written test and problem identification & solution.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests(20)	Assignments (05)	Presentation (10)	External Participation in Curricular/Co-Curricular

				Activities (0)
Remember	8			
Understand	5			
Apply	3			
Analyze	2			
Evaluate	2			
Create				

*Attendance 05

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	24
Understand	20
Apply	4
Analyze	8
Evaluate	4
Create	

Course Code: PHARM 3104 Course Title: Biopharmaceutics-I
Marks: 100 Credits: 03

Rationale: This is a major course of Bachelor of Pharmacy program that provides basic information of biopharmaceutics and various core parameters of pharmacokinetics. It does also provide the knowledge of bioavailability, IVIVC and prodrug designing.

Objectives:

- To provide basic knowledge on pharmacokinetics and various pharmacokinetic parameters.
- To make students understand the core concept of drug absorption and bioavailability.
- To enable the students in correlating in vitro bioavailability with in vivo bioavailability.
- To impart knowledge on protein binding and distribution of drugs and correlate it with efficacy.
- To make students understand drug biotransformation as a key determinant of drug clearance.
- To provides knowledge on prodrug and prodrug designing.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Understand and describe different parameters of pharmacokinetics.
CLO2	Illustrate the basic principles of drug absorption and relate it with physiology, physicochemical properties and dosage form.
CLO3	Learn about bioavailability and correlate in vitro bioavailability with in vivo bioavailability
CLO4	Know about distribution of drug inside body and how protein binding regulates distribution as well as efficacy of a drug.
CLO5	Understand how the drug bio-transforms and clears out from the body, and can correlate the disease condition with drug availability.
CLO6	Conceptualize the principle and significance of prodrug designing.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3									
CLO2	3	2			1					
CLO3	3	2			1					
CLO4	3	2			1					
CLO5	3	2			1					
CLO6	3	3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course contents**	**Hrs**	**CLOs**
01	**Introduction to biopharmaceutics:** Biopharmaceutics, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, toxicokinetics, measurement of drug concentrations, and interpretation of drug-plasma level curve.	4	CLO1
02	**Gastrointestinal absorption of drugs**: a) **Biological consideration**: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc. b) **Physicochemical consideration:** pKa and gastrointestinal absorption, pH partition theory and other physicochemical factors. c) **Dosage form consideration**: Role of different dosage forms like solution, suspension, tablet, capsule, emulsion etc. on gastrointestinal absorption.	10	CLO2 CLO3

	d) **Disintegration and dissolution of drugs:** Factors influencing dissolution, dissolution test apparatus, in-vitro & in-vivo correlations of dissolution, drug release patterns.		
03	**Distribution of drugs**: a) Important pharmacokinetic parameters such as biological half-life, apparent volume of distribution, area under the curve, elimination rate constant etc. b) Interpretation of drug-plasma level curve. **c)** Drug-protein interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of binding sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.	10	CLO4
04	**Drug clearance:** a) Theoretical aspects of drug elimination, excretion and biotransformation. b) Renal elimination: Glomerular filtration, active tubular secretion, tubular reabsorption, determination of renal clearance. c) Biotransformation of drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michelis-Menten equation), hepatic elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance). d) Biliary excretion of drug.	8	CLO5
05	**Bioavailability and Bioequivalence:** Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute to bioavailability, methods of assaying bioavailabilty, criteria for bioequivalence studies, method and determination of bioavailability.	10	CLO6

Text Book:

Leon Shargel and Andrew B : Applied Biopharmaceutics and Pharmacokinetics

References books:

1. Milo Gibaldi: Biopharmaceutics and Clinical Pharmacokinetics
2. D M Brahmankar Sunil B. Jaiswal: Biopharmaceutics and Pharmacokinetics – A Treatise

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies

CLO1	**Introduction to biopharmaceutics**	Lecture, Question-Answer session, PPT Demonstration	Class test (Short Q and MCQ) assignment
CLO2	**Gastrointestinal absorption of drugs**	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO3	**Gastrointestinal absorption of drugs**	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	**Distribution of drugs**	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ)
CLO5	**Drug clearance**	Lecture, Question-Answer session, Discussion	Class test (Short Q and MCQ) Presentation
CLO6	**Study of Prodrugs**	Lecture, PPT Demonstration, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes/ Presentation (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	4	2	2	
Apply	5	2	4	
Analyze	4			
Evaluate	3			
Create		1	2	

*Class Attendance: 05

Semester Final Examination (60 Marks)

Bloom's Category	Marks
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	5

Course Code: PHARM 3105 Course Title: Pharmaceutical Biotechnology
Marks: 100 Credits: 03

Rationale: Understanding the principles and application of biotechnological methods in different fields and their utilization in advance patient care and public health.

Objectives

The aim of the course is to-

- To gather knowledge about biotechnology and its application in medicine, foods, forensic science, microbial and plant genetics.
- To know different biophysical and biochemical analysis of recombinant proteins.
- To understand the basic principles of recombinant DNA technology and production of biotech compounds.
- To understand formulation and site specific delivery of biotech products.
- To gather knowledge about Fermentation Technology
- To understand basic principles of immunology and hybridoma technology for production of monoclonal antibody.
- To familiarize him/herself with different techniques of pharmaceutical production of biotech product.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Name the basic principle of genetic recombination and application of biotechnology in different fields.
CLO2	Explain the method of preparation and evaluation of biotech products *i.e.* vaccines, sera and other immunological preparations.
CLO3	Demonstrate the knowledge of fermentation, genomic DNA extraction, and isolation of plasmid DNA from given culture in pharma-biotech industries.
CLO4	Describe in detail about the different types of antibodies, hybridoma technology for production of monoclonal antibodies
CLO5	Estimate biophysical and biochemical analysis of recombinant proteins.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	2								
CLO2	2	3			2				
CLO3	2				2				
CLO4	2				2				
CLO5	2				2				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**

01	**Introduction of biotechnology and its application in medicine, foods, forensic science, microbial and plant genetics:** Different dimension of biotechnology and pharmaceutical biotechnology.	6	CLO1
02	**Biophysical and biochemical analysis of recombinant proteins**: Protein structure, protein folding, analytical techniques,Enzyme-linked immunosorbent assay (ELISA).	5	CLO5
03	**Recombinant DNA technology and production of biotech compounds**: Basic principle, genetic recombination- cloning, gene expression, restriction endonuclease, ligase and other enzymes used in gene cloning, cloning vectors, transfection method, cultivation and downstream processing, issues to consider in production and purification of proteins, pharmaceutical application of recombinant DNA technology	7	CLO2
04	**Formulation andsite specific deliveryof biotech products**: Microbiological considerations, excipients used in parenteral formulations of biotech products, delivery of proteins, routes of administration and absorption enhancement, Approaches for rate controlled and target site specific delivery.	6	CLO2 , CLO3
05	**Fermentation Technology**: Introduction to fermentation technology, improvement of industrial strains of microorganisms, fermentative, medium and inoculum development, biological products obtained from fermentation.	6	CLO3
06	**Immunolgy:** Monoclonal antibody, hybridoma technology, basic principles of immunology, antigen and haptens, vaccines.	6	CLO4
07	**Pharmaceutical production**: Short study of current biotech products- Interleukins and interferons, insulin, vaccines, monoclonal antibody-based pharmaceuticals, follicle stimulating hormone (FSH), trustuzumab; dispensing of biotechnology products- storage temperature requirements, storage in dosing and administration devices, light protection, handling, mixing and shaking, shipment requirements, preparation and administration	6	CLO1 CLO2

Text Books:

1. S.P. Vyas and V.K. Dixit: Pharmaceutical Biotechnology
2. Daan J. A. et al.: Pharmaceutical Biotechnology

References books:

1. K. Sambamurthy and A. Kar : Pharmaceutical Biotechnology
2. W. Crueger and A. Crueger : Biotechnology, A Textbook of Industrial Microbiology

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Introduction of biotechnology and its application in medicine, foods, forensic science, microbial and plant genetics	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Quiz, assignment
CLO5	Biophysical and biochemical analysis of recombinant proteins	Lecture, Online VDO, Discussion, Group study for problem analysis	Presentation
CLO2	Recombinant DNA technology and production of biotech compounds	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO2, CLO3	Formulation and site specific delivery of biotech products	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ)
CLO3	Fermentation Technology	Lecture, Discussion, Question-Answer session	Class test
CLO4	Immunology	Lecture, Question-Answer session	Class test
CLO1, CLO2	Pharmaceutical production	Lecture, Question-Answer session	Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (05)	Presentation (10)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	5			
Understand	8			
Apply	3			
Analyze	2			
Evaluate	2			
Create				

*Attendance 05

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	24
Understand	18
Apply	8
Analyze	5
Evaluate	5
Create	

Course Code: PHARM 3106 Course Title: Pharmaceutical Analysis-I-Lab
Marks:100 Credits: 02

Rationale: To confer practical knowledge about assay of some commonly used raw materials and dosage form utilizing conventional analytical procedures.

Objectives:

- To develop basic practical skills using instrumental techniques.
- To inculcate theoretical knowledge on various instrumental techniques adopted for analysis of pharmaceuticals.
- To develop various methodologies for assay of drugs and pharmaceuticals with the skills and knowledge gained.
- To understand and gain knowledge on trouble shooting in adopting various methodologies using instrumental techniques.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Determine the potency of raw materials as well as pharmaceutical dosage forms by using different types of titrimetric method of drug analysis
CLO2	Determine the quality and purity of drugs using different titrimetric techniques.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	2	2								
CLO2	2	2								

SL No.	Course Contents	Hrs	CLOs
01	Assay of acetyl salicylic acid in aspirin tablets.	10	CLO1 CLO2
02	Determination of potency of penicillin tablets.	11	CLO1 CLO2
03	Non- aqueous assay of phenobarbitone tablets.	10	CLO1 CLO2
04	Assay of magnesium and aluminum from antacid preparation.	11	CLO1 CLO2
05	Determination of potency of vitamin tablets.	12	CLO1 CLO2

Text Book:

1. Aurther 1. Vogel, Long man, England.: A Textbook of Quantitative Inorganic Analysis, Vol. I & II

References books:

1. United State Pharmacopoeia, United States Pharmacopoeia Convention, Inc.
2. British Pharmacopoeia.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

Course Learning Outcome (CLO)	Teaching-Learning Strategies	Assessment Strategies
CLO1	White board and Lab experiments.	Quiz, Collecting data through observation and experimentation.
CLO2	White board and Lab experiments.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 50)	Lab reports (10)	Quizzes (20)	External Participation in Curricular/Co-Curricular Activities (0)
Remember		4	
Understand		4	
Apply		3	
Analyze		5	
Evaluate		4	
Create			

*Attendance 10

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	5
Understand	10
Apply	15
Analyze	15
Evaluate	15
Create	

Course Code: PHARM 3107 Course Title: Pharmacology-II- Lab
Marks: 100 Credits: 02

Rationale: Understanding the pharmacological effect of various types' drugs on experimental animals.

Objectives:

- To provide practical knowledge and observe the effects of various types of drugs on biological system.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Gain practical knowledge and observe the effects of various types of CNS drugs on rats and toads
CLO2	Observe the effects of anesthetic agent and how they work on experimental animals.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2			3					
CLO2	3	2			3					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Content	Hrs	CLOs
1.	Handling of experimental animals: mice and rat.	5	CLO1
2.	Different routes of administration of drugs in experimental animals.	5	CLO1
3.	Study of drugs acting on CNS **a)** CNS stimulant drugs (strychnine, ephedrine, amphetamine). **b)** CNS depressant drugs (barbiturates induced sleeping time).	5	CLO1

4.	Effect of pilocarpine on saliva secretion of rat.	5	CLO1
5.	Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.	4	CLO2
6.	Effect of local anesthetics on rats tail.	4	CLO1
7.	Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).	4	CLO2
8.	Diuretic effect of Furosemide. Study of the effects of diuretics and antidiuretics on the rate of urinary flow in animal (toad/ mice/ rats).	6	CLO2

Text Book:

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

References books:

1. H. P. Rang, M. M. Dale: Pharmacology
2. K. D. Tripathi: Essentials of Medical Pharmacology
3. R. A. Harvey, P. C. Champe: Lipponcott's Illustrated Reviews Pharmacology
4. Andres Goth: Medical Pharmacology
5. B. G. Katzung: Basic and Clinical Pharmacology
6. R. S. Satoskar and Bhandarkar: Pharmacology and Pharmacotherapeutics Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Handling of experimental animals: mice and rat.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Different routes of administration of drugs in experimental animals.	Written test, Quiz, Collecting data through observation and experimentation.
CLO1	Study of drugs acting on CNS **a)** CNS stimulant drugs (strychnine,ephedrine, amphetamine). **b)** CNS depressant drugs (barbiturates induced sleeping time).	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Effect of pilocarpine on saliva secretion of rat.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

CLO2	Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.	Written test, Quiz, Collecting data through observation and experimentation.
CLO1	Effect of local anesthetics on rats tail.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Study of the effects of diuretics and antidiuretics on the rate of urinary flow in animal (toad/ mice/ rats).	Written test, Quiz, Collecting data through observation and experimentation.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks)

Bloom's Category Marks (out of 15)	**Lab Performance Test (10)**	**Lab reports (05)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	1.5	2.5	
Understand	1	2.5	
Apply	1.5		
Analyze	1		
Evaluate	2.5		
Create	2.5		

*Lab Attendance 05

SEE- Semester End Examination (30 Marks)

Bloom's Category	**TEST (25)**	**Viva Voce (05)**
Remember	2.5	1
Understand	2.5	1
Apply	2.5	1
Analyze	2.5	1
Evaluate	7.5	1
Create	7.5	

Course Code: PHARM 3108 Course Title: Medicinal Chemistry-I- Lab
Marks: 100 Credits: 02

Rationale: Designed to help students to develop their practical skills in the field of drug synthesis.

Objectives:

- To gather knowledge about how to Synthesize and characterize different types of medicinally important compounds.
- To know different techniques to prepare the analogues of different drugs.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Synthesize and characterize different typesof medicinally important compounds.
CLO2	Prepare different analogues of drugs using different reaction technique.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2			2					
CLO2	2	2			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
	Laboratory synthesis, physical, chemical and spectral characterization of the following Compounds:		
01	Paracetamol	6	CLO1,CLO2
02	Benzocaine	6	CLO1,CLO2
03	Aspirin	7	CLO1,CLO2
04	Phenacetin	6	CLO1,CLO2
05	PABA (para amino benzoic acid)	6	CLO1,CLO2
06	Meta nitro benzaldehyde	7	CLO1,CLO2
07	Ethyl para hydroxy benzoate	7	CLO1,CLO2
08	Para amino phenol	6	CLO1,CLO2
09	Methyl salicylate	6	CLO1,CLO2

Text Book

1. B.S. Bahl and Arun Bahl, Advanced Organic Chemistry

References books:

1. R.T. Morrison and R.N. Boyd, Organic Chemistry
2. I.L. Finar, Organic Chemistry Vol. I & II
3. Ashutosh Kar, Medicinal Chemistry

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	2		2	
Understand	5	2	4	
Apply	5	2	4	
Analyze	5			
Evaluate				
Create	3	1		

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	15
Apply	15
Analyze	10
Evaluate	5

Course Code: PHARM 3201 Course Title: Pharmaceutics-II
Marks: 100 Credits: 03

Rationale: This course is rationale for undergraduate students. The purpose of this course is to provide the basic knowledge about formulation and evaluation of tablet, capsule, drug stability. In addition, this course deals with deeper insight of preformulation study for a pharmaceutical dosage form.

Objectives:

- To gain a concept how to start a pharmaceutical formulation.
- To provide knowledge about manufacturing of different pharmaceutical dosages forms, e.g.; tablet, capsule and remedies of their manufacturing difficulties.

- Todissimulate lessons among students about the effect of compression of powder on tablet formation, and its different excipients on tablet formation also.

Course Learning Outcomes (CLOs): At the end of this course, students will be able to-

CLO1	Accumulate basic ideas about the preformulation study for a pharmaceutical dosage form.
CLO2	Know the development ability in utilization of powder in tablet formulation.
CLO3	Facilitate necessary knowledge about manufacturing and formulation of tablet with its common problems and tablet coating.
CLO4	Acquire concept about properties of granular particle in compression state, problems associated in large scale manufacturing.
CLO5	Gather knowledge about the formulation, filling, and evaluation of capsules.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2			3					
CLO2	3	3			2	3	1			
CLO3	2	3				1	1			
CLO4	2	3			1	1				
CLO5	3	3			2		1			

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Pre-formulation Study** Preliminary evaluation and molecular optimization, bulk characterization of the material crystalinity and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis, pKa determination, pH solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability.	6	**CLO1**
02	**Formulation and Manufacturing of Tablets** Advantages and classification of tablets, formulation and granulation of powders for tableting, manufacturing of tablets by wet granulation, dry granulation and by direct	6	**CLO2**

	compression, different types of tablet compression machinery and equipment.		
03	**Common Tableting Problems and Evaluation of Tablets** Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, in process quality control methods in tablet manufacturing, study of common tableting problems and their solution.	6	**CLO3**
04	**Compaction and Compression of Powder** Physics of tablet compression, mechanism of tablet formation, bonding to tablets, the effect of compressional force on tablet properties, effect of lubricants on tablet compression and binding, factors affecting the strength of tablet, mechanism of bonding to tablets, instrumented tablet machines and tooling, problems associated with large scale manufacturing of tablets.	8	**CLO4**
05	**Tablet Coating** Definitions and classification of coating methods, advantages and disadvantages of coated tablets, different methods of coating- sugar coating, different stages of sugar coating, problems of sugar coating; film coating- theory of film coating, film formers, plasticizer, solvents, other excipients; enteric coating- enteric coating polymers, formulations of enteric coating, dry coating (compression coating), comparison between sugar coating and film coating, aqueous film coatingtechniques, modern film coating materials and coating formulations, problems of organic and aqueous film coating; coating machines: conventional coating machines, perforated coating machines, fluidized coating machines.	8	**CLO3**
06	**Capsules** **a) Hard Gelatin Capsules** Definition and classification, advantages and limitations of capsule dosage form, gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories, problems in capsule manufacturing, quality control methods of capsules, packaging of capsules. **b) Soft Gelatin Capsules** Definitions and classifications, advantages and limitations, properties,formulation, manufacturing, quality control and	8	**CLO5**

	packaging of soft capsules, problems and remedy of soft capsule manufacturing.		

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Pre-formulation Study	Lecture, Online Video, PPT Demonstration, Group discussion.	Class test (Short Q and MCQ) Quiz, Presentation, Assignment
CLO2	Tablet	Lecture, , Online Video, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), Presentation, assignment
CLO2	Formulation and manufacturing of tablets	Lecture, , Online Video, Question-Answer session	Class test (Short Q and MCQ), Quiz, Presentation, assignment
CLO2	Common tableting problems and evaluation of tablets	Lecture, , Online Video, Question-Answer session	Class test (Short Q and MCQ), Quiz, Presentation, assignment
CLO3	Tablet coating	Lecture, Online Video, Discussion, PPT Demonstration	Class test (Short Q and MCQ), Assignment
CLO4	Compaction and compression of powder.	Lecture, Online Video, PPT Demonstration, Group discussion, Group study for problem analysis	Class test (Short Q and MCQ), Assignment
CLO5	Capsules	Lecture, Online Video, PPT Demonstration, Group discussion, Group study for problem analysis	Class test (Short Q and MCQ), Assignment

Text Book:

1. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy

References books:

1. E. A. Rawlins: Bentley's Textbook of Pharmaceutics
2. S. J. Carter: Cooper and Gunn's Dispensing for Pharmaceutical Students
3. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design
4. Randy Hendrickson et. al. : Remington, The Science and Practice of Pharmacy

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes /Presentation (5)	Attendance (5)
Remember	10			
Understand	5			
Apply	3			
Analyze	2			
Evaluate				
Create				

SFE- Semester Final Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	40
Understand	15
Apply	3
Analyze	2
Evaluate	
Create	

Course Code: PHARM 3202 Course Title: Pharmaceutical Engineering
Marks: 100 Credits: 03

Rationale: Understanding the fundamental knowledge of construction materials, material handling systems, drying and mixing process and plan layout of pharmaceutical manufacturing plant.

Objectives:

- To gather knowledge about drying, milling, crystallization, centrifugation, mixing, air conditioning and refrigeration.
- Toimply knowledge of these processes in formulation and trouble shooting.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Understand drying, its importance to formulation and different drying techniques and dryer machines.
CLO2	Demonstrate filtration, milling, crystallization, centrifugation and mixing in drug products manufacturing

CLO3	Explain air conditioning, refrigeration & humidity Control.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	**3**	**3**			**2**					
CLO2	**2**	**3**			**3**					
CLO3	**3**	**3**			**3**					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Drying:** Definition, importance of drying, terminology, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content. equilibrium moisture content, classification : direct, indirect, radiation, dielectric, batch and continuous, dryers, types of beds: static, moving, fluidized, pneumatic bed systems, different drying equipments(construction, operation, merits, demerits): tray dryer, through-circulation dryer, pneumatic conveying dryer, different types of dryers.	4	CLO1
02	**Filtration:** Definition, importance of filtration, difference with expression, sedimentation and drying. Classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment :(construction, operation, merits and demerits) the gravity nutsche, delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, Eimco-Burwell plates and frames, Readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney Hunt pressure filter, Moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipment.	4	CLO2
03	**Centrifuges:** General principles, magnitude of centrifugal force, materials of construction, critical speed. sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.	2	CLO2
04	**Mixing:** Solid-Solid Mixing: Importance, fundamentals, batch homogeneity, different types of solids-mixing machines there advantages and disadvantages. Paste Mixing: Definition, importance, simple blending, dispersion operations and general equipment design. Various paste mixers there advantages and disadvantages.	2	CLO2

	Liquid Mixing: Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, others liquid mixers their advantages and disadvantages.		
05	**Milling:** Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process, methods of size reduction by cutter mill, roller mill, hammer mill, ball mill, vibration mill, edge runner mill, end runner mill, fluid energy mill, hand mill, colloid mill (principle, design, operation and advantages) and selection of a mill.	4	CLO2
06	**Air Conditioning, Refrigeration & Humidity Control:** **Air conditioning:** Definition, importance, pharmaceutical application, differences between air conditioner & air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air conditioned room, pharmaceuticals needing air conditioning. **Refrigeration:** Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage. Humidity control: Terminology (psychometry, absolute humidity, relative humidity, dew point, humid heat, humid volume, wet bulb temperature and adiabatic saturation temperature), relationship between wet bulb and adiabatic saturation temperatures, humidifier, dehumidifier, uses of psychometric charts, measurement of humidity and applications of humidity control.	4	CLO3

Text Books:

1. L. Lachman, et al.: The Theory and Practice of Industrial Pharmacy
2. A. R. Gennaro: Remington, The Science and Practice of Pharmacy

References books:

1. Elementary Engineering Drawing: N. D. Bhatt and V. M. Panchal
2. Pharmaceutical Engineering; principles and practices-CVS Subrahmanyam.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	6	1	2	
Understand	4	2	4	
Apply	4	2	4	

Analyze	4			
Evaluate	2			
Create				

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	20
Apply	15
Analyze	5
Evaluate	5

Course Code: PHARM 3203Course Title: Biopharmaceutics-II
Marks: 100 Credits: 03

Rationale: This is a major course of Bachelor of Pharmacy program that develops a good understanding of different pharmacokinetic parameters, data analysis, calculations and their applications in practical clinical situations. It also helps the students to improve their skills for formulation and solving pharmacokinetic problems.

Objectives

- To provide basic biopharmaceutical knowledge on pharmaceutical dosage forms and new drug delivery systems.
- To impart insights on various pharmacokinetic models and how to use those models to calculate pharmacokinetic parameters.
- To enable the students to design a multiple dosage regimen and intravenous infusion to enhance therapeutic efficacy.
- To provide knowledge on pharmacokinetic variability due to renal disease and adjust the dosage regimen accordingly.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Utilize pharmaceutical and Biopharmaceutical knowledge in the production of dosage forms and development of new drug delivery systems
CLO2	Calculate pharmacokinetic parameters from drug concentration–time data important for therapeutic response using different compartmental models.
CLO3	Analyze the absorption kinetics and bioavailability of oral dosage forms.
CLO4	Design multiple-dose regimen important to produce plasma concentrations within the therapeutic window.

CLO 5	Calculate loading dose and maintenance dose of an IV infusion to enhance therapeutic efficacy.
CLO 6	Recognize the renal disease related factors that can cause pharmacokinetic variability. Calculate to adjust the dose for a drug in a patient with renal disease.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	1			2					
CLO2	3	2			1	2				
CLO3	3	1								
CLO4	3	2			1	2				
CLO5	3	2			1	2				
CLO6	3	2				2				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course contents**	**Hrs**	**CLOs**
01	**Compartmental analysis:** Introduction: a) One compartment open model, determination of plasma concentration from one compartment open model, calculation of apparent volume of distribution, calculation of K from urinary excretion data. b) Multiple-Compartment models: (i) Two compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant (ii) Three compartment open model: method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.	8	CLO1 **CLO2**
02	**Pharmacokinetics of drug absorption:** Zero order absorption model, first order absorption model, determination of absorption rate constants from oral absorption data: method of residuals Wagner Nelson method, determination of k_a from two comportment oral absorption data, Loo Riegelman method.	10	CLO1, CLO3
03	**Multiple dosage regimens (MDR):** Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bio-equivalency from MDR.	8	CLO4
04	**Intravenous Infusion**: One-compartment model drugs, two-compartment model drugs, infusion plus loading dose.	6	CLO5

05	**Dosage adjustment in renal disease:** a) Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance, method based on changes in the elimination rate constant, measurement of glomerular filtration rate (GER), calculation of creatinine, clearance from serum. Dose adjustment based on Nomogram, GiustiHayton, and Wagner method. b) Extracorporeal removal of drugs, dialysis.	7	CLO6

Text Book:

1. Leon Shargel and Andrew B : Applied Biopharmaceutics and Pharmacokinetics

Reference Books:

1. Milo Gibaldi: Biopharmaceutics and Clinical Pharmacokinetics
2. D M Brahmankar Sunil B. Jaiswal: Biopharmaceutics and Pharmacokinetics – A Treatise

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Compartmental analysis, Pharmacokinetics of drug absorption	Lecture, Question-Answer session, PPT Demonstration	Class test (Short Q and MCQ) assignment
CLO2	Compartmental analysis	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO3	Pharmacokinetics of drug absorption	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	Multiple dosage regimens (MDR)	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ)
CLO5	Intravenous Infusion	Lecture, Question-Answer session, Discussion	Class test (Short Q and MCQ) Presentation
CLO6	Dosage adjustment in renal disease	Lecture, PPT Demonstration, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

Continuous Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes/ Presentation (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	4	2	2	
Apply	5	2	4	
Analyze	4			
Evaluate	3			
Create		1	2	

***Class Attendance: 05**

Semester Final Examination (60 Marks)

Bloom's Category	**Marks**
Remember	15
Understand	15
Apply	10
Analyze	10
Evaluate	5
Create	5

Course Code: PHARM 3204 Course Title: Pharmaceutical Marketing and Management
Marks: 100 Credits: 03

Rationale: To study the basics of pharmaceutical marketing and management that prepares individuals for careers in pharmaceutical sales, marketing, management, and related fields within the health care industry.

Objectives:

- To describe the concept of pharmaceutical marketing.
- To enumerate the concept of product management in pharmaceutical industry.
- To discuss the various components of promotion of pharmaceutical products.
- To explain the different pharmaceutical marketing channels.
- To discuss the role and responsibility of professional sales representative.
- To discuss the roles and responsibilities of pricing authorities in India.
- To discuss the emerging concepts of marketing.

- To discuss the role market research.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Describe the concept of pharmaceutical marketing.
CLO2	Enumerate the concept of product management in pharmaceutical industry.
CLO3	Discuss the various components of promotion of pharmaceutical products.
CLO4	Explain the different pharmaceutical marketing gateways.
CLO5	Discuss the role and responsibility of professional sales representative.
CLO6	To review the ethical perspectives of marketing and importance of different marketing environment and processes.
CLO7	To define the general principles of business development & management and role of communication in marketing environment.
CLO8	To develop Strategies for establishing successful business & its marketing and tackling problems in environment.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2		2	2				3		
CLO2	1						3	3	1	
CLO3	2		1	1			3	3	1	
CLO4	2		2	2			3	3		
CLO5	2		2	2			2	3		
CLO6	1		1	1			3	3		
CLO7	2		2	2				3		
CLO8			2					3		

SL No.	**Course Contents**	**Hrs**	**CLOs**
01.	**A. Pharmaceutical Marketing**		
	1. Basics of Marketing: Needs, wants and demands; product, value, cost, satisfaction; exchange, transaction and relationship; markets, marketing and marketers.	4	CLO1
	2. Production, Product, Selling and Marketing Concepts: Marketing process- selecting marketing opportunities, targeting the market, product positioning, formulating marketing strategy and plans, organizing, and implementing and controlling marketing efforts.	6	CLO2, CLO3, CLO5
	3. Pharmaceutical Marketing Environments: Demographic factor, competitive factors, social and cultural factors, technology, government and legal factors.	4	CLO1, CLO3
	4. Market Segmentation: Necessity of market segmentation, therapeutic market, OTC market, wholesale market, and government market, foreign market.	4	CLO1, CLO2

	5. Formulation of Marketing Strategies and New Product Launches: Establishing competitive edge, product differentiation, service differentiation, product positioning, medical treatment problems. Screening, business and medical analysis, organizing launching program.	6	CLO2, CLO4, CLO6
02	**B/. Pharmaceutical Management**		
	6. Managerial Role of Pharmacists: Pharmacists in different services of health and pharmaceutical industry- pharmaceutical production and quality control, marketing and sales, regulatory affairs, training, medical information services, research and development, hospital pharmacy, community pharmacy, NGOs, education consultancy.	6	CLO5, CLO7, CLO8
	7. Management, Planning and Organizing: Nature and purpose of management, managerial function, role and skill; social responsibility and ethics of pharmaceutical managers.Nature, types of plans, planning steps and processes, decision making in different environments. Process of organizing, organizational structure, line and staff concepts, delegation.	6	CLO7, CLO8
	8. Staffing and Controlling: Recruitment process and technique, training and development.	6	CLO7, CLO8

Text Book:

1. Rickey W. Griffin : Management

References books:

1. Philip Kotler: Marketing Management: Analysis, Planning, And Control

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Basics of Marketing, Pharmaceutical Marketing Environments, Market Segmentation	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Assignment
CLO2	Production, Product, Selling and Marketing Concepts; Market Segmentation; Formulation of Marketing Strategies and New Product Launches	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Assignment

CLO3	Production, Product, Selling and Marketing Concepts; Pharmaceutical Marketing Environments	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ)
CLO4	Formulation of Marketing Strategies and New Product Launches	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ)
CLO5	Production, Product, Selling and Marketing Concepts; Managerial Role of Pharmacists	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO6	Formulation of Marketing Strategies and New Product Launches	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO7	Managerial Role of Pharmacists, Management, Planning and Organizing, Staffing and Controlling	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO8	Managerial Role of Pharmacists, Management, Planning and Organizing, Staffing and Controlling	Lecture, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (20 out of 28)	**Tests (20)**	**Assignments (10)**	**Quiz/Presentation (5)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	2		1	
Understand	6	4	2	
Apply	6	4	1	
Analyze	3	2	1	
Evaluate	3			
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks)

Bloom's Category	Marks
Remember	5
Understand	20
Apply	10
Analyze	10
Evaluate	10
Create	5

Course Code: PHARM 3205 Course Title: Pharmaceutical Regulatory Affairs
Marks: 100 Credits: 03

Rationale: To acquire knowledge about pharmacy related laws, acts, ordinance, policy, rules and regulation, pharmacist professionalism and ethics.

Objectives:

- To provide knowledge about ethics and professionalism of pharmacist
- To impart knowledge regarding regulatory process in pharmacy council.
- To provide an understanding regarding licensing and drug approval procedure for ensuring proper manufacturing and rational use of medications

Course Learning Outcomes (CLOs): at the end of the Course, the Student will be able to-

CLO1	To understand the basic law and ethics as vital requirement for pharmacy practice.
CLO2	To become familiarized with ethics and professionalism of pharmacist.
CLO3	To know the punishment for violation of pharmacy law.
CLO4	To understand the regulatory process in pharmacy council.
CLO5	To achieve knowledge of responsibilities of DGDA in drug regulations.
CLO6	Learn about licensing and drug approval procedure for ensuring proper manufacturing and rational use of medications.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	3	3	3	3	2	1	3	3	
CLO2	3			3	1	3	3	3	
CLO3	2	1		3	3	3	1	1	1
CLO4	2		3	3					1

CLO5	3	3	3	2				3	1

SL No	Course Content	Hrs.	CLOs
01	Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976), the role of the Pharmacy Community of Bangladesh, the role of pharmacists in operating and maintaining model pharmacies and model medicine shops	3	CLO1 & CLO2
02	**The Pharmacist's code of ethics**	4	CLO1
03	**An introductory study on the Policies, sales, regulations, and laws concerning the manufacture, possession, distribution, and sale of drugs and poisonsin Bangladesh (with the latest amendments):** The Drug Act 1940 (XXIII of 1940) The Drug Ordinance 1982 The National Drug Policy 1982 The Drug (Control) Ordinance 1982 (Ordinance No. VIII of 1982), its amendments; Drug Control Ordinance 2006 The Narcotics (control) Act 1990 The National drug policy 2005 and 2016 for regulation of the process of registration, manufacture, distribution, sale, import, and export of drugs in Bangladesh. The Poisons Act 1919 and related amendments	12	CLO2 & CLO3
04	**cGMP of Pharmaceutical manufacturing:** ·Evolution and Principles of cGMP, Schedule-M, WHO-GMP requirements, European Union (EU) and United States Food and Drug Administration (USFDA) guidelines on Pharmaceutical manufacturing.	12	CLO5
05	**Regulatory requirements for new product approval:** 1.Regulatory requirements for product approvals obtaining New Drug Application (NDA), Abbreviated New Drug Application (ANDA) for generic drugs, regulatory inspection system, Approval process, format and registration of Active Pharmaceutical Ingredients, Biologics, Novel therapies, special categories in Bangladesh, stability study, BE study, validation & qualification 2. Control of drug advertisements and prices, patented and trademarked medicine, proprietary medicine, regulation of cosmetics and poison control.	06	CLO6
06	Control of drug advertisements and prices patented and trademarked medicine, proprietary medicine, regulation of cosmetics, and poison control.	06	CLO6

07	**Harmonization of regulatory requirements:** The International Conference on Harmonization (ICH) process, guidelines to establish quality, safety and efficacy of drug substances and products. Study of ICH common technical documents (CTD), harmonization of pharmacopoeial standards The International Organization for Standardization (ISO) 9000 series of quality systems standards, ISO 14000, licensing of premises.	06	CLO6
08	**Globalization of drug industries:** Export import policy of drugs, WHO –certification, Trademarks, copyrights and patents, vendor qualification, post marketing surveillance.	03	CLO2

Text Book:

1. Jon Merrill's and Jonathan Fisher, Pharmacy Law and Practice, Elsevier Science; 5 edition 2013.

References books:

1. The Pharmacy Ordinance, 1976, Ministry of Law and Parliamentary affairs, Government of Bangladesh.
2. The Drugs (Control) Ordinance, 1982, Ministry of Law and Land Reforms, Government of Bangladesh,
3. Drug Policy of Bangladesh, Ministry of Health and Population Control, Health Division, Dhaka.
4. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh.
5. Remington: the Science and Practice of Pharmacy, 22 edition, 2015
6. Drug acts and rules.
7. A Textbook of Forensic Pharmacy- B M Mithal

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1 & CLO2	Regulations and laws governing the practices of pharmacy in Bangladesh	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO1	The Pharmacist's code of ethics	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO2 & CLO3	An introductory study on the Policies, sales, regulation and laws concerning to the manufacture, possession,	Lecture, Question-Answer session	Class test (Short Q and MCQ)

	distribution, sale of drugs and poisons in Bangladesh		
CLO5	cGMP of Pharmaceutical manufacturing	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO6	Regulatory requirements for new product approval	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ), assignment
CLO6	Harmonization of regulatory requirements	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), assignment
CLO2	Globalization of drug industries	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO3	Overview of ICH guideline.	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Presentation
CLO5	Pharmacovigilance and Antibiotic Policy	Lecture, Question-Answer session	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	
Understand	5	3	2	
Apply	2	4	1	
Analyze	2	2	1	
Evaluate	2	1		
Create	1			

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	25
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	

Course Code: PHARM 3206 Course Title: Pharmaceutics-II Lab
Marks: 100 Credits: 02

Rationale: This course is rationale for undergraduate students. The purpose of this course is to demonstrate the student's laboratory concept about formulation, preparation and evaluation of different solid, semisolid and liquid dosage forms such as tablets, capsule, ointments, solution, syrup, emulsion and suspension.

Objectives:

- Make students skillful on formulation and quality evaluation of different pharmaceutical dosages forms like; syrups, suspensions, emulsions, ointments.
- Gain ability to formulate and evaluate qualities tablets (antihistamine tablets, dispersible, aspirin tablet) and capsule.
- Acquire lessons on 16-station rotary table press machine.

Course Learning Outcomes (CLOs): At the end of this course, the students will be able to-

CLO1	Develop skills on preparation of syrups, suspensions and emulsions and Facilitate necessary knowledge about preparation and evaluation of syrups, suspensions and emulsions.
CLO2	To gain knowledge about different components of a 16-station rotary table press.
CLO3	To acquire knowledge about the formulation and evaluation of different tablets, for instance; antihistamine tablets, dispersible aspirin tablet.
CLO4	To accumulate practical knowledge on manufacturing and quality control of capsule dosage form.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3			2					
CLO2	2	3			2		1			
CLO3	2	3			2		1			
CLO4	2	3			2		1			

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course content	Hrs	CLOs
1.	Formulation and compounding of different syrups.	4	CLO1
2.	Formulation and compounding of different suspensions.	8	CLO1
3.	Formulation and compounding of different emulsions.	8	CLO1
4.	Formulation and compounding of ointments.	8	CLO1
5.	Study of different components of a 16-station rotary table press.	6	CLO2
6.	Formulation and manufacturing of antihistamine tablets.	8	CLO3
7.	Formulation and manufacturing of dispersible aspirin tablet.	8	CLO3
8.	Formulation and manufacturing of some capsule dosage form.	6	CLO4

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	Teaching-Learning Strategies	Assessment Strategies
CLO1	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO2	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO3	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO4	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments

Text Book:

1. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy

References books:

1. E. A. Rawlins : Bentley's Textbook of Pharmaceutics
2. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students
3. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design
4. H. C. Ansel and N. G. Popovich : Pharmaceutical Dosage Forms and Drug Delivery Systems
5. Randy Hendrickson et. al. : Remington, The Science and Practice of Pharmacy

Course Code: PHARM 3207 Course Title: Biopharmaceutics-Lab
Marks: 100 Credits: 02

Rationale: This is a fundamental lab course in the Bachelor of Pharmacy program that provides the practical knowledge for evaluating different drug products to understand the effects of biopharmaceutical parameters on dissolution and absorption of drugs.

Objectives

The aim of the course is to-

- Impart knowledge about various evaluation tests of tablet and capsule dosage form.
- Provide insights on biopharmaceutical parameters like disintegration and dissolution.
- Enable students to conduct in vitro dissolution tests of immediate release and sustained release tablets.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Understand the evaluation of pharmaceutical dosage forms such as, tablet and capsule and their packaging.
CLO2	Conduct basic quantitative analysis to understand the effects of biopharmaceutical parameters on disintegration, dissolution and absorption of drugs.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3		1	2					
CLO2	3	3		1	2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hours**	**CLO**
01	Tablet weight variation test.	1	CLO1
02	Tablet hardness test.	1	CLO1
03	Tablet friability test.	1	CLO1
04	Capsule weight variation test.	1	CLO1
05	Leakage test of packaging of tablets/capsules.	1	CLO1
06	Disintegration test for film coated tablets.	3	CLO2
07	Disintegration test for capsules.	2	CLO2
08	Dissolution test for capsules.	3	CLO2
09	Determination of drug release time from enteric coated tablet	3	CLO2
10	In vitro dissolution study of immediate release tablet.	3	CLO2
11	In vitro dissolution study of SRDF theophylline capsule.	7	CLO2

Text Book:

1. British Pharmacopoeia. 2020. British Pharmacopoeia Commission; Volume: I to III.
2. The Official Compendia of Standards USP 44, NF 39.2021, Volume I to V, United States Pharmacopeial Convention, Inc.; Asian edition. Tata Donnelley Limited, India.
3. Indian Pharmacopoeia 2018 (IP 2018)

Reference Books:

1. Sean C. Sweetman., 2009. Martindale: The Complete Drug Reference. 36th Edition. Pharmaceutical Press, U.K.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment StrategyS

Course Learning Outcome (CLO)	Teaching-Learning Strategies	Assessment Strategies
CLO1	White board and Lab experiments.	Quiz, Collecting data through observation and experimentation.
CLO2	White board and Lab experiments.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

ASSESSMENT PATTERN:

Continuous Evaluation (40 Marks)

Bloom's Category (35 out of 40)	Tests (20)	Lab note preparation (10)	External Participation inCurricular/Co-Curricular Activities (0)
Remember	5	2	
Understand	5	2	
Apply	3	2	
Analyze	3		
Evaluate	2	2	
Create	2	2	

***Class Attendance: 05**

Semester Final Examination (60 Marks)

Bloom's Category	Marks
Remember	12
Understand	12
Apply	12
Analyze	10
Evaluate	8
Create	6

Course Code: PHARM 3208 Course Title: Viva voce-III
Marks: 50 Credits: 01

Rationale: The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board.

Objective: This course gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Learn how to approach themselves before an interview board.
CLO2	Overcome the fear or nervousness of facing face to face interview or interaction.
CLO3	Present their concepts systematically in oral form.
CLO4	Prepare them for future job interview.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3								2	
CLO2	3								2	
CLO3	3									
CLO4									3	

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course content**	**Hrs**	**CLOs**
1.	Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire third year including semester I and semester II.	-	CLO1 CLO2 CLO3 CLO4

Text Book:

3. All books relevant to courses studied during first year first and second term.

Reference books:

5. Marc Dorio. Complete Idiot's Guide to the Perfect Interview. 2nd edition, 2000; Alpha Books.
6. Susan Hodgson. Brilliant Answers to Tough Interview Questions. 5th edition, 2015; FT Press

Course Code: PHARM 4101 Course Title: Pharmaceutical Analysis-III
Marks: 100 Credits: 03

Rationale: To study recent trends in analytical science and techniques and be introduced to advanced pharmaceutical technologies, such as formulations and clinical pharmacokinetics.

Objectives:

- To understand the importance of analysis in pharmaceutical industry.
- To understand the knowledge about assay of pharmaceutical substance and product.
- To develop basic practical skills using instrumental techniques.
- To inculcate theoretical knowledge on various instrumental techniques adopted for analysis of pharmaceuticals.
- To develop various methodologies for assay of drugs and pharmaceuticals with the skills and knowledge gained.
- To understand and gain knowledge on trouble shooting in adopting various methodologies using instrumental techniques.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Interpret theories and principles of different types of chromatographic techniques.
CLO2	Interpret the theories and principles of different types of spectroscopic methods for the identification of organic compounds.
CLO3	Select suitable spectroscopic method for the testing of pharmaceutical products.
CLO4	Evaluate the process regarding different pharmaceutical analysis both in research and industrial purpose.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	1			1					
CLO2	2	1			1					
CLO3	2	1			1					
CLO4	2	1			1					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
1	**Chromatographic Methods:** **a) High Performance Liquid Chromatography:** Introduction and theoretical considerations, instrumentation, characteristics of stationary and mobile phases, reversed phase high performance liquid chromatography, latest development -UPLC & UFLC, applications. **b) Gas Chromatography:** Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.	20	CLO1
2	**Spectroscopic techniques:** **a) Infrared (IR) Spectroscopy:** IR absorption process, methods of vibration and bending, bond properties and absorption trends, IR	22	CLO1, CLO2,

	spectrophotometer, approaching the analysis of a IR spectrum, use of IR spectrum. **b) Nuclear Magnetic Resonance Spectroscopy:** ^{1}HNMR spectroscopy: introduction and theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling; two dimensional NMR spectroscopy, nuclear over hauser effect, 2D correlated (COSY) and 2D nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC. **c) ^{13}CNMR Spectroscopy:** Introduction, principle, chemical shift, spin-spin coupling, applications.		CLO3, CLO4

Text Book:

1. Gurdeep R. Chatwal et al.: Instrumental Methods of Chemical Analysis

Reference Books:

1. A.H. Beckett, et al : Practical Pharmaceutical Chemistry Vol. I & II
2. K. A. Connors : A Textbook of Pharmaceutical Analysis
3. L.G. Chatten : Pharmaceutical Chemistry Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Chromatographic Methods	Lecture, Group study for problem analysis	Class test (Short Q and MCQ) Assignment
CLO2	Polarography and Amperometric Titration, X-ray Crystallography	Lecture, Group study for problem analysis	Class test (Short Q and MCQ) Assignment
CLO3	Spectroscopic techniques, Mass Spectrometry, X-ray Crystallography	Lecture, Group study for problem analysis	Class test (Short Q and MCQ)
CLO4	Formulation of Marketing Strategies and New Product Launches, Mass Spectrometry	Lecture, Group study for problem analysis	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (20 out of 28)	**Tests (20)**	**Assignments (10)**	**Quiz/Presentation (5)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	6	4	2	
Apply	6	4	1	
Analyze	2	2		
Evaluate	2			
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks)

Bloom's Category	**TEST (60)**
Remember	20
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	5

Course Code: PHARM 4102 Course Title: Drug and Disease Management
Marks: 100 Credits: 03

Rationale: This course provides knowledge about various types of diseases and their management.

Objectives:

- To provide knowledge about shifts in healthcare provision that led to the emergence of disease management.
- To impart knowledge about business case for implementing disease management.

Course Learning Outcomes: at the end of the Course, the Student will be able to-

CLO1	To explain the pressures associated with the development of the disease management model of care.
CLO2	To describe the shifts in healthcare provision that led to the emergence of disease management.
CLO3	To discuss the business case for implementing disease management.
CLO4	To explain the disease management process and the roles of disease management team members.
CLO5	To explain current healthcare policies and practices that will influence the future of disease management.
CLO6	To predict different drug interactions and implement effective measures.

Mapping of Course Outcomes to Program Outcomes-

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9
CLO1	3	3	3	2	2	1	3	3	1
CLO2	3			3	1	3	3	3	
CLO3	2	1		3	3	3	1	1	
CLO4	2		3	3					2
CLO5	3	3	3	1				3	2

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs.	CLOs
01	**GIT Disease:** Dyspepsia and peptic ulcer disease, lower gastrointestinal problems, the liver patient.	4	CLO1
02	**Rheumatoid Arthritis and Osteoarthritis:** The drug and non-drug measures used to manage osteoarthritis and the modern therapeutic approach used in the treatment of rheumatoid arthritis.	4	CLO2 & CLO3
03	**Management and treatment of different cardiovascular:** hypertension, hyperlipidemia, ischaemic heart disease, heart failure.	4	CLO4 & CLO5
04	**Respiratory Disease:** clinical features, diagnosis, goals of treatment, management, pharmacological basis of management, treatment, monitoring, drug interactions, counseling of asthma and COPD.	4	CLO1
05	**Management of Renal Disease:** Treatment & management of tuberous sclerosis, nephropathy, chronic kidney disease; blood pressure control, management of protein to control renal disease.	6	CLO5
06	**Management of Central Nervous System Disorders:** Treatment & management of migraine, epilepsy, anxiety disorders, insomnia, schizophrenia, drug interactions, over the counter medicines and dietary supplements, counseling.	4	CLO4

07	**Hepatic Disease and Their Management:** Sign and symptoms, common causes, complications, diagnosis, and management of alcoholic liver disease, acute liver failure, drug and toxin induced hepatotoxicity, liver cirrhosis, management of patients with chronic liver diseases, treatment of viral hepatitis (B and C) etc.	6	CLO4
08	**Drug Interactions:** Six pharmacokinetic mechanisms by which interactions may occur, giving a clinical example of each; three pharmacodynamic mechanisms by which interactions may occur, giving a clinical example of each two examples of a drug-food interaction; two examples of a drugalcohol interaction, one example of a drug-tobacco interaction.	4	CLO6

Text Book:

1. Helms et al: Textbook of Therapeutics Drug & Disease Management

Reference Books:

1. Randall and Neil: Disease Management

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	GIT Disease	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2, CLO3	Rheumatoid Arthritis and Osteoarthritis	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO3	Pharmaceutically acceptable glass and water	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4, CLO5	Management and treatment of different cardiovascular	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO1	Respiratory Diaease	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO5	Management of Renal Disease	Lecture, Question-Answer session	Class test (Short Q and MCQ)

CLO4	Management of Central Nervous System Disorders	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO4	Hepatic Disease and Their Management	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO6	Drug Interactions	Lecture, Question-Answer session	Class test (Short Q and MCQ)

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	
Understand	5	3	2	
Apply	4	4	1	
Analyze	2	2	1	
Evaluate	1	1		
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	20
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	5

Course Code: PHARM 4103 Course Title: Medicinal Chemistry-II
Marks: 100 Credits : 03

Rationale: This course is added to confer knowledge about the process of drug discovery and drug design.

Objectives:

- To understand the basic principles of medicinal chemistry in pharmacy
- To gather knowledge about drug discovery, design and development.

- To know different drug design for pharmacokinetcs problems
- To understand methods of drug metabolism
- To gather knowledge about various types of drug targets, identification and validation
- To familiarize him/herself with chemistry, sar, mode of action and synthesis of some common essentials drugs.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Know about the target oriented discovery, design, and development of drugs
CLO2	Describe various design parameters of drugs and target sites to solve pharmacokinetcs Problems
CLO3	Describe the pathways and sites of drug metabolism
CLO4	Correlate drug metabolism and drug design
CLO5	Discuss the chemistry, structure activity relationship, structure determination and synthesis of drugs

Mapping of Course outcomes to program outcomes:

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2				1					
CLO2	2				1					
CLO3	3				1					
CLO4	2				1					
CLO5	2				1					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Drug Design and Discovery:** **a)Drug Design:** Definition, purposes and factors governing of drug design, interpretation of SAR of small molecules (sulfa drugs), design of pharmaceutical dosage forms. **b)Drug Discovery:** Discovery of new drugs without leads, lead discovery strategies, requirements for identification of lead compounds. **c)Drug Development:** Objectives, pharmacophore, patterns and SAR of drug development from natural sources, modification synthetic analogues, bioisosterism, and homologation.	6	CLO1

02	**Drug Design for Pharmacokinetcs Problems:** Metabolic blockers, prodrugs, sentry drugs, 'search and destroy' drugs, Self-destruct drugs, drug distribution and survival of drugs.	6	CLO1 CLO2
03	**Drugs Metabolism:** Pathways of drugs metabolism, metabolism of various groups of drugs, factors affecting drugs metabolism, methods of studying drug metabolism, new aspect of drug metabolism, metabolic products of common drugs.		CLO3 CLO4
04	**Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs:** a) Antimicrobial agents: Semisynthetic penicillins, cephalosporins and quinolone derivatives. b) Antidiabetic drugs: Sulfonyl ureas, biguanides. c) Local anaesthetics: Benzocaine, procaine. d) Non-steroidal oestrogens: Stilbesterol, hexesterol, dienesterol.	20	CLO5

Text Books:

1. Graham L. Patrick: Cooper and Gunn's Dispensing for Pharmaceutical Students
2. Wilson and Gisvold: Textbook of Organic, Medicinal and Pharmaceutical Chemistry

Reference Books:

1. Ashutosh Kar : Medicinal Chemistry
2. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Drug Design and Discovery	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO1, CLO2	Drug Design for Pharmacokinetcs Problems	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO3, CLO4	Drugs Metabolism	White board, PPT presentation, self-study of relevant materials.	Quiz, Class test and self-generated question solution.

CLO5	Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs	White board, PPT presentation, self-study and case study.	Quiz, written test and problem identification & solution.

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (05)**	**Presentation (10)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8			
Understand	7			
Apply	3			
Analyze	2			
Evaluate				
Create				

*Attendance 05

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	24
Understand	22
Apply	8
Analyze	6
Evaluate	
Create	

Course Code: PHARM 4104 Course Title: Bioinformatics
Marks: 50 Credits: 02

Rationale: To acquire the core concepts of Bioinformatics, including computational biology, database design and implementation.

Objectives:

- To apply reasoning about core biological concepts with emphases on the cellular and molecular scale of biology.

- To design, implement and evaluate computer-based systems, processes, components or programs in relation to the contexts of molecular and cellular biology and genomics research.
- To analyze and evaluate bioinformatics data to discover patterns, critically evaluate conclusions and generate predictions for subsequent experiments.
- To communicate biological information relating to bioinformatics in both written and oral forms.
- To work competently in a group on biological concepts in relation to bioinformatics.
- To demonstrate comprehension of basic concepts of biological literacy.

Course Learning Outcomes (CLOs): At the end of the course, the student will be able to-

CLO1	Get introduced to the basic concepts of Bioinformatics and its significance in biological data analysis.
CLO2	Learn the chemical principles that underline biochemistry, molecular biology and genomics.
CLO3	Learn the design and implementation of relational databases.
CLO4	Learn advanced methods in computational biology.
CLO5	Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
CLO6	Learn the basics of sequence alignment and analysis.
CLO7	To gain knowledge about various concepts employed in drug discovery and its applications towards personalized medicine which involves specific analysis of genes important for drug response and drug effect.
CLO8	To get exposed to various tools and methodologies used in multiple sequence alignment, phylogenetic analysis and genetic diversity analysis observed in biological sequences.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			2			3		
CLO2	3	2			2			3		
CLO3	3	2			2			3		
CLO4	3	2			2			3		
CLO5	3	2			2			3		
CLO6	3	2			2			3		
CLO7	3	2			2			3		

CLO8	3	2			2			3		

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	Introduction: Definition of bioinformatics, basic concepts of protein and nucleic acid, sequence, structure and function.	8	CLO1, CLO2
02	Biological Databases: General introduction of biological databases, types of databases, common databases related to bioinformatics.	6	CLO1, CLO3, CLO5
03	Sequence Alignment and Database Searching: Single sequence alignments, biological motivation, pairwise alignments, database searching including BLAST, multiple sequence alignments.	8	CLO6, CLO8
04	Phylogenetics in Bioinformatics: Sequence-based taxonomy, from multiple alignment to phylogeny, computer tools for phylogenetic analysis.	6	CLO8
05	Data storage: File Format (Genbank, DDBJ, FASTA, PDB, SwissProt), introduction to metadata and search; Protein motif and domain.	6	CLO5, CLO6
06	Molecular docking: Introduction to molecular docking, preparation of ligand and protein for docking, grid box, non-bonding interactions, associated bonds in molecular docking, PyMOl, PyRx, BIOVA Discovery studio visualizer.	4	CLO4, CLO7

Text Book:

1. Larson: Bioinformatics & Drug

Reference Books:

1. CHouristineOrengo: Bioinformatics: Genes, Proteins and Computers

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning & Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Introduction, Biological Databases	Lecture, Question-Answer session	Class test (Short Q and MCQ) assignment
CLO2	Introduction	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO3	Biological Databases	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO4	Molecular docking	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ)

CLO5	Biological Databases, Data storage	Lecture, Question-Answer session	Class test (Short Q and MCQ) Presentation
CLO6	Sequence Alignment and Database Searching, Data storage	Lecture, Question-Answer session	Class test (Short Q and MCQ) Presentation
CLO7	Molecular docking, Gene Expression and and Representation	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation
CLO8	Sequence Alignment and Database Searching, Phylogenetics in Bioinformatics	Lecture, Online VDO, Discussion,Group study for problem analysis	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category (20 out of 28)	**Tests (20)**	**Assignments (10)**	**Quiz/Presentation (5)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	4		2	
Understand	6	4	2	
Apply	6	4	1	
Analyze	2	2		
Evaluate	2			
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks)

Bloom's Category	**TEST (60)**
Remember	20
Understand	20
Apply	5
Analyze	5
Evaluate	5
Create	5

Course Code: PHARM 4105 Course Title: Cosmetology
Full Marks: 100 Credits: 03

Rationale: To acquire knowledge about formulation and evaluation of various cosmetics and dental preparations.

Objectives:

1. To learn the importance of cosmetics in daily life.
2. To familiarize with the quality parameters of cosmetic preparations.
3. To know the manufacturing process of cosmetic products.
4. To understand the advantages and disadvantages of using skin care, dental care, hair care products**.**

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To know about the skin structure and importance of percutaneous absorption for cosmetic preparations.
CLO2	Know the formulation and manufacturing process of cosmetics and dental product
CLO3	Demonstrate the techniques for preparation of skin cream, shaving cream, hair care, lips and shaving products
CLO4	To gain knowledge about various human care and dental care products.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3				2				2
CLO2	3	3				2		1		2
CLO3	2	2				1		1		2
CLO4	3	2				2		1		2

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**The Skin**: Introduction, epidermis and keratinizing system, pigment system, langerhans cell, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin.	8	CLO1 CLO2 CLO4
02	**Raw Materials Used in Cosmetic Preparations**: Commonly used surface-active agents, humectants, antiseptics, preservatives, antioxidants, cream bases, perfumes, colors.	4	CLO2 CLO3
03	**The Manufacture of Cosmetics**: Introduction, mixing and the manufacture of bulk cosmetic products, solid-solid mixing, manufacture of pigmented powder products, mixing processes involving fluids, general principles of fluid mixing, mixing equipments	6	CLO2 CLO3 CLO4

	for fluids, solid-liquid mixing, suspension of solids in agitated tanks, liquid-liquid mixing: miscible liquid, immiscible liquid.		
04	**Skin Care Products**: Introduction, classification of skin creams, cold creams, cleansing creams, night and massage creams, moisturizing, vanishing and foundation creams, pigmented foundation creams, sun screen products, acne products, lipsticks.	10	CLO1 CLO2 CLO3 CLO4
05	**Shaving Preparations**: Introduction, lather shaving cream, brush less or non-lathering cream, aerosol shaving foams, after-shave preparations.	4	CLO2 CLO3
06	**Dental Products**: Introduction, dentrifrices, formulation and manufacturing of toothpastes and tooth powders, mouth wash, oral rinses.	4	CLO2 CLO3 CLO4
07	**Hair Products**: Introduction, shampoos, hair setting lotions, hair tonics and conditioners. Shampooing: A study of the techniques and methods used in shampooing and the removal of chemical products, including conditioning, re-conditioning, and rinse applications**.** Treatment of the Hair & Scalp: Recognition of hair and scalp disease, and those conditions which require medical treatments as well as those that can be treated by the cosmetologist. Methods of treatments and scientific brushing. Methods used in the art of tinting and bleaching hair**.**	6	CLO2 CLO3 CLO4

Text books:

1. S. N. Sahu: Preparation and distribution of Drugs and Cosmetics.
2. J. B. Wilkison, R. J. Moore: Harry's Cosmeticology

References books:

1. M. S. Balsam and E. Sagarin: Cosmetics, Science and Technology Vol. I & II.
2. Pulok K. Mukherjee: Quality control of herbal drugs.
3. A. Barel, Marc Payne et al.: Handbook of Cosmetic Science & Technology.
4. Elsner and Howard I. Maibach: Cosmeceuticals and Active Cosmetics.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1, CLO2, CLO4	The Skin	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ) Quiz, assignment
CLO2, CLO3	Raw Materials Used in Cosmetic Preparations	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), written test, assignment
CLO2, CLO3, CLO4	The Manufacture of Cosmetics	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), assignment

CLO1, CLO2, CLO3, CLO4	Skin Care Products	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), written test, assignment
CLO2, CLO3	Shaving Preparations	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), written test, assignment
CLO2, CLO3, CLO4	Dental Products	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), written test, assignment
CLO2, CLO3, CLO4	Hair Products	Lecture, White board, PPT presentation, Question-Answer session, Discussion	Class test (Short Q and MCQ), assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8	2	1	
Understand	6	4	2	
Apply	2	3	1	
Analyze			1	
Evaluate	2	1		
Create	2			

*Class Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	20
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	5

Course Code: PHARM4106 Course Title: Pharmaceutical Analysis-II- Lab
Marks:100 Credits: 02

Rationale: The intent of the course is to confer practical knowledge about the assay of some commonly used raw materials and dosage form using modern method of analysis.

Objectives

- To learn analyzing active ingredients and determining quality and purity of drugs.
- To know different techniques to qualify and quantify API and impurities.
- To gather knowledge of spectroscopic methods.

Course Learning Outcomes (CLOS): at the end of the course, the student will be able to-

CLO1	Learn estimating the potency of APIand impurities by using different types of modern techniques
CLO2	Determine the quality and purity of drugs using different titrimetric techniques
CLO3	Identify of the compounds by spectroscopic methods.

Mapping of Course Learning outcomes (CLOs) to Program Learning outcomes (PLOs)

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2			2					
CLO2	2	2			2					
CLO3	2	2			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	Estimation of ampicillin by UV spectrophotometric method	4	CLO1, CLO3
02	Estimation of active drug in domperidone tablet by UV spectrophotometric method.	4	CLO2, CLO3
03	Determination of protein concentration in tissue preparation by UV-Vis spectrometry	2	CLO2, CLO3
04	Estimation of ferrous fumarate from iron capsule	2	CLO2, CLO3
05	Determination of ampicillin by iodometric titration.	4	CLO2, CLO3
06	Determination of potency of atenolol in the tablet by volumetric and coductometric method.	4	CLO1,CLO3
07	Determination of captopril potency in the tablet by volumetric and coductometric method	4	CLO1, CLO3

08	Compare the titration curves using conductometric method when (a) 0.01 N solution of HCl (b) 0.01N solution of oxalic acid (c) 0.01N solution of acetic acid and (d) 0.01 N solution of acetyl salicylic acid are condutometrically determined with a standard solution of sodium hydroxide.		CLO2, CLO3
09	Potentiometric determination of the concentrations of an iodide and a chloride sample in a mixture.		CLO2, CLO3
10	Determination of protein level in enzymatic drug.		CLO1, CLO3

Text Book:

1. A Textbook of Quantitative Inorganic Analysis, Vol. I & II- Aurther 1. Vogel, Long man, England.

References books:

1. United State Pharmacopoeia, United States Pharmacopoeia Convention, Inc.
2. British Pharmacopoeia.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks)

Bloom's Category (35 out of 40)	**Tests (20)**	**Assignments (5)**	**Quizzes (10)**	**External Participation inCurricular/Co-Curricular Activities (0)**
Remember	3		2	
Understand	6	2	4	
Apply	5	2	4	
Analyze	4	1		
Evaluate	2			
Create				

***Class Attendance: 05**

SEE- Semester End Examination (60 Marks)

Bloom's Category	**Marks**
Remember	10
Understand	15
Apply	15
Analyze	10
Evaluate	10

Course Code: PHARM 4107 Course Title: Medicinal Chemistry-II-Lab
Marks: 100 Credits: 02

Rationale: Designed to help students to develop their practical skills in the field of drug synthesis.

Objectives

- To gather knowledge about synthesis and characterization of different compounds of medicinal importance.
- To understand preparation of different analogs of drugs by acetylation, methylation, oxidation and reduction.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Synthesize and characterize of different compounds of medicinal importance
CLO2	Prepare different analogues of drugs by different analytical technique

Mapping of Course outcomes to program outcomes:

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3			2					
CLO2	2	3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course content**	**Hrs**	**CLOs**
1.	**Synthesis and characterization of different compounds of medicinal importance:** Benzocaine, Nicotinamide, Isoniazid, Tramodol, Celecoxib, Trimethoprim, Antiboitics, Antihistamines, Sulphonamides.	26	**CLO1**
2.	**Preparation of different analogs of drugs by**: Acetylation, Methylation, Oxidation, Reduction	26	**CLO2**

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topics**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Synthesis and characterization of different compounds of medicinal importance	White board and Lab experiments.	Quiz, Collecting data through observation and experimentation.

CLO2	Preparation of different analogs of drugs	White board and Lab experiments.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.

Text Book:

1. Abraham, D.J. and Myers, M., 2021. Burger's Medicinal Chemistry, Drug Discovery and Development, 8 Volume Set. John Wiley & Sons.
2. 2. Neumeyer, J.L., 2012. Medicinal Chemistry. Foye's Principles of Medicinal Chemistry, p.1.

References books:

1. The Laboratory Manual Prepared by Pharmacy Discipline

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Lab Performance/ Tests (20)**	**Lab reports (10)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	5		
Understand	5		
Apply	3		
Analyze	2		
Evaluate	3		
Create	2		

*Attendance 10

SEE- Semester End Examination (60 Marks):

Bloom's Category (60)	**TEST (50)**	**Viva (10)**
Remember	5	
Understand	5	
Apply	5	
Analyze	15	
Evaluate	15	
Create	5	

Course Code: PHARM 4108 Course Title: Cosmetology-Lab
Credits: 02 Marks : 100

Rationale: To acquire practical knowledge about formulation and evaluation of various types of cosmetics.

Objectives:
The objectives of the course are to-

1. Make the students skillful on preparation of various cosmetics like cream, shampoo, lotion, powder, etc.
2. Develop skills of the students to evaluate various cosmetics like cream, shampoo, lotion, powder, etc.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Manufacture of cream.
CLO2	Manufacture of Shampo, conditioner and bath oil.
CLO3	Manufacture of lotion and shaving cream.
CLO4	Manufacture of tooth powder and telecom powder.
CLO5	Evaluate cream.
CLO6	Evaluate Shampo, conditioner and bath oil.
CLO7	Evaluate lotion and shaving cream.
CLO8	Evaluate tooth powder and telecom powder.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3			1	2				
CLO2	3	3			3	2				
CLO3	3	3			2					
CLO4	3	3			2					
CLO5	3	3			2					
CLO6	3	3			2					
CLO7	3	3			2					
CLO8	3	3			2					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
1	Formulation and preparation of cold cream and vanishing cream.	7	**CLO1**
2	Formulation and preparation of transparent shampoo, conditioner and bath oil.	**7**	**CLO2**

3	Formulation and preparation of after shave lotion and shaving cream.	**7**	**CLO3**
4	Formulation and preparation of tooth powder and telecom powder.	**7**	**CLO4**
5	Evaluation of cold cream and vanishing cream.	**7**	**CLO5**
6	Evaluation of transparent shampoo, conditioner and bath oil.	**7**	**CLO6**
7	Evaluation of after shave lotion and shaving cream.	**7**	**CLO7**
8	Evaluation of tooth powder and telecom powder.	**7**	**CLO8**

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Teaching-Learning Strategies	Assessment Strategies
CLO1	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO2	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO3	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO4	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO5	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO6	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO7	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.
CLO8	Lecture, Lab experiments, group discussion	Lab performance test, Viva Voce, experimental result and Lab final script evaluation.

Text Book:

1. Chemistry and Technology of the Cosmetics and Toiletries Industry- D. F., Williams and W. H. Schmitt, Hardcover, Kluwer Academic Publications.

Reference Books:

1. Harry's Cosmetology- J. B. Wilkinson & R. J. Moore, Longman

2. Modern Cosmetics~ Perfumes, Cosmetics and Soaps, Vol. I, II and III- W. A. Poucher, Chapman & Hall, London.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 30)	**Lab Performance Test (20)**	**Lab reports (10)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	3	5	
Understand	2	5	
Apply	3		
Analyze	2		
Evaluate	5		
Create	5		

*Lab Attendance 10

SEE- Semester End Examination (60 Marks)

Bloom's Category	**TEST (50)**	**Viva Voce (10)**
Remember	5	2
Understand	5	2
Apply	5	2
Analyze	5	2
Evaluate	15	2
Create	15	

Course Code: PHARM 4201 Course Title: Pharmaceutics-III
Marks: 100 Credits: 03

Rationale: This course is rationale for undergraduate students. The purpose of this course is to provide the basic knowledge about formulation and evaluation of suppositories, sustained release dosage form, parenteral products,ophthalmic products, aerosol science and technology. This course also deals with deeper insight of microencapsulation technology.

Objectives:

- To familiarize student with suppositories formulation, its advantages and disadvantages over other formulations.
- To help student to gain knowledge on microencapsulation technology.
- To provide the knowledge on manufacturing, formulation, packaging and evaluation of sustained release dosage form, and ophthalmic products.

- To give idea on parenteral products, its types, formulation, and evaluation.
- To educate students on formulation and evaluation of aerosols.

Course Learning Outcomes (CLOs): At the end of this course, students will be able to

CLO1	Acquire knowledge about manufacturing and formulation of suppositories.
CLO2	Assist the students to develop ability on microencapsulation technology.
CLO3	Provide the knowledge of manufacturing and formulation of sustained release dosage form.
CLO4	Gather concept on manufacturing, formulation and evaluation of parenteral products and ophthalmic products.
CLO5	Provide the knowledge of manufacturing and quality assurance of aerosols.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**
CLO1	2	3			2	2			
CLO2	2	3			2				
CLO3	2	3			2				
CLO4	2	3			1				
CLO5	2	3			1				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Suppositories** Drug absorption from colon, Ideal requirements of suppositories, advantages & disadvantages, classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, packaging and testing of suppositories.	7	**CLO1**
02	**Microencapsulation Technology** Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.	7	**CLO2**
03	**Sustained Release Drug Delivery Systems** Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form.	8	**CLO3**
04	**Parenteral Products** Definition and classification of parenteral products, formulation considerations- **a)**Pre-operational factors, water for injection, pyrogenecity, non-aqueous vehicles, isotonicity and methods of its adjustment. **b)** Formulation techniques, containers and closures and their selection.	8	**CLO4**

	c) Prefilling treatments, washing of containers and closures, preparation of solutions and suspensions, filling and closing of ampules, vials, infusion fluids, lyophillization and preparation of sterile products, equipment for the manufacture of sterile products. **d)** Methods of maintaining sterility. **e)**Evaluation of parenteral products by instrumentaland biological methods, LAL test and pyrogen.		
05	**Ophthalmic Products** Anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, safety considerations of ophthalmic products, formulation, vehicles and additives, manufacturing considerations, environment, manufacturing techniques, quality control of ophthalmic products, packaging of ophthalmic products.	6	**CLO4**
06	**Aerosol Science and Technology** Definition and classification of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, containers and valves for aerosols, metered dose delivery of aerosols, manufacturing of aerosols, testing and quality assurance of aerosols.	6	**CLO5**

Text Book:

1. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy

Reference Books:

1. E. A. Rawlins: Bentley's Textbook of Pharmaceutics
2. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students
3. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design
4. H. C. Ansel and N. G. Popovich : Pharmaceutical Dosage Forms and Drug Delivery Systems
5. Randy Hendrickson et. al.: Remington, The Science and Practice of Pharmacy

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	Topic	Teaching-Learning Strategies	Assessment Strategies
CLO1	Suppositories	Lecture, , Online Video, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) Quiz, Presentation, Assignment
CLO2	Microencapsulation technology	Lecture, , Online Video, PPT Demonstration, Group discussion	Class test (Short Q and MCQ), Presentation, assignment
CLO3	Sustained Release Drug Delivery Systems	Lecture, , Online Video, Question-Answer session	Class test (Short Q and MCQ), Quiz, Presentation, assignment

CLO4	Parenteral Products	Lecture, Online Video, Discussion, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ), Assignment
CLO4	Ophthalmic Preparation	Lecture, Online Video, PPT Demonstration, Group discussion, Group study for problem analysis	Class test (Short Q and MCQ), Assignment
CLO5	Aerosol Science and Technology	Lecture, Online Video, Discussion, PPT Demonstration, Group study for problem analysis	Class test (Short Q and MCQ), Assignment

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes /Presentation (5)**	**Class Attendance (5)**
Remember	10			
Understand	5			
Apply	3			
Analyze	2			
Evaluate				
Create				

SFE- Semester Final Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	40
Understand	15
Apply	3
Analyze	2
Evaluate	
Create	

Course Code: PHARM 4202Course Title: Pharmacology-III
Marks: 100 Credits: 03

Rationale: This course provides knowledge about various types of diseases and their management.

Objectives:

1. To provide knowledge various cardiovascular drugs, their mechanism of action, indication, contraindication, their dose and available market products
2. To impart knowledge about effects of medicines on the human body.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To know about various cardiovascular drugs, their mechanism of action, indication, contraindication, their dose and available market products.
CLO2	To know about various types of antibiotics, antidiabetic drugs, vitamin and Drug acting on ANS.
CLO3	To know about various Chemotherapeutic agents , their mechanism of action, indication, contraindication, their dose and available market products
CLO4	To correlate pathogenesis of disease to mechanism of drugs.
CLO5	To understand the effects of medicines on the human body.
CLO6	To become familiarized with the effects of medicines on pathological state of cells and tissues of particular organ.
CLO7	To describe mechanisms of therapeutic agents.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3				2	3				
CLO2	3	2			2	3				
CLO3	3	3			3	2				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	Course Contents	Hrs	CLOs
01	**Cardiovascular Drugs**: Introduction, classification, mechanism of action of: a) Antihypertensive drugs b) Antiarrhythmic drugs c) Diuretics d) Drugs used in heart failure e) Drugs used in angina and myocardial infarction	10	CLO1, CLO6, CLO7
02	**Antidiabetic** Agents: Introduction to diabetes, classification, causes, complications and treatment of diabetes, hypoglycemia, causes and treatment, relationship between stroke and diabetes, causes of stroke, different types of antihyperglycemic agents with mechanisms, uses, toxicity; Insulin resistance, management of diabetes, glucagon mechanism, uses.	12	CLO2, CLO6, CLO7

03	**Antibacterial Agents:** Introduction, classification, mode of action and brief study of the following class of drugs a) Drugs affecting folate synthesis b) β-lactam antibiotics c) Drugs affecting protein synthesis d) Drugs affecting Topoisomerase-I enzyme-fluoroquinolones. f)Antitubercular agents g)Antileprotic drugs	12	CLO3, CLO6, CLO7, CLO5
04	**Chemotherapeutic Drugs:** Immonosuppressive Agents: Cytotoxic drugs, glucocorticoids, antibodies, specefic T-cell inhibitors. Antineoplastic Drugs: Alkylating agents, antimetabolites, antibiotics,, microtubule inhibitors Antiviral Drugs: Anti-herpes virus, ant retro virus, anti-influenza virus, nonselective antiviral drugs, drugs used in acquired immune deficiency syndrome (AIDS)	10	CLO3
05	**Antifungal Drugs:** Amphotercin B, flucytosine, itracouzale, ketoconzole, fluconazole, nystatin,griseofulvin.	4	CLO6, CLO7

Text Book:

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

Reference Books:

1. H. P. Rang, M. M. Dale: Pharmacology
2. K. D. Tripathi : Essentials of Medical Pharmacology
3. R. A. Harvey, P. C. Champe: Lipponcott's Illustrated Reviews Pharmacology
4. Andres Goth: Medical Pharmacology
5. B. G. Katzung : Basic and Clinical Pharmacology
6. R. S. Satoskar and Bhandarkar: Pharmacology and Pharmacotherapeutics Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1, CLO6, CLO7	Cardiovascular Drugs	Lecture, PPT Demonstration, Group discussion	Class test (Short Q and MCQ) assignment
CLO2, CLO6, CLO7	Antidiabetic Agents	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) Presentation

CLO3, CLO6, CLO7, CLO5	Antibacterial Agents	Lecture, Question-Answer session	Class test (Short Q and MCQ)
CLO3	Chemotherapeutic Drugs	Lecture, Online VDO, Discussion, Group study for problem analysis	Class test (Short Q and MCQ) assignment
CLO6, CLO7	Antifungal Drugs	Lecture, Question-Answer session	Class test (Short Q and MCQ) Presentation

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	**Tests (20)**	**Assignments (10)**	**Quizzes/ Presentation (5)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	8		1	
Understand	5	3	2	
Apply	4	4	1	
Analyze	2	2	1	
Evaluate	1	1		
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	**TEST (60)**
Remember	20
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	5

Course Code: PHARM 4203 Course Title: Medicinal Chemistry-III
Marks: 100 Credits: 03

Rationale: This course is added to confer knowledge about the process of drug discovery and drug design.

Objectives:

- To learn about drug design and development.

- To understand the chemistry of drug molecules.
- To familiarize with computational drug design and development.
- To know about the structure activity relationship of different drug molecules and utilize them in the synthesis of new drug entities.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Know about the target oriented discovery, design, and development of drugs
CLO2	Describe combinatorial chemistry of drug molecules
CLO3	Get idea about the computer aided drug design
CLO4	Discuss the chemistry, structure activity relationship, structure determination and synthesis of drugs and vitamins

Mapping of Course outcomes to program outcomes:

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3			2		2	1		
CLO2	2	3			2		2	2		
CLO3	3	3			2		2	2		
CLO4	2	3			2		2	1		

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
01	**Combinatorial Chemistry and Rapid Parallel Syntheses:** **a)** Introduction, various drug discovery processes, design, diversity, expression, methods & techniques, and applications of combinatorial syntheses on drug discovery. **b)** Solid phase syntheses: introduction, various linkers, solid phase peptide synthesis (SPPS): principle, mechanism and application; heterocyclic synthesis. **c)** Liquid phase combinatorial synthesis, dendrimer: supported combinatorial chemistry.	10	CLO1
02	**Introduction of Computational Molecular Modeling of Drug Design:** Quantitative structure activity relationships (QSAR): physicochemical properties (hydrophobicity, electronic effects, steric factors, solvent accessible surface area etc), application of QSAR (Hansch equation, Hammett relationships) on biological systems.	10	CLO3
03	**Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs:** **a)** Psychotropic drugs and antidepressants: TCA compounds, MAOIs, phenothiazine derivatives. b) Antineoplastic drugs: alkylating agents, antimetabolites, plant products. c) General anaesthetics: propofol, etomidate, isoflurane,	10	CLO2, CLO4

	benzodiazepines and barbiturates. d) Antimalarial agents: Chloroquine, pamaquine, trimethoprim.		
04	**Vitamins:** Synthesis, clinical aspects of vitamins and their effects on free radicals.	6	CLO4
05	**Signal Transduction and its role in drug design.**	6	CLO1, CLO4

Text books:

1. Wilson and Gisvold: Textbook of Organic, Medicinal and Pharmaceutical Chemistry
2. Graham L. Patrick: An Introduction to Medicinal Chemistry

Reference Books:

1. Ashutosh Kar: Medicinal Chemistry
2. W.O. Foye: Principles of Medicinal Chemistry
3. E. J. Ariens: Drug Designs Vol. I, II & III
4. Alfred Burger:Medicinal Chemistry Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Combinatorial Chemistry and Rapid Parallel Syntheses	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO3	Introduction of Computational Molecular Modeling of Drug Design	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ) Quiz, assignment
CLO2, CLO4	Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs	White board, PPT presentation, self-study of relevant materials.	Quiz, Class test and self-generated question solution.
CLO4	Vitamins	White board, PPT presentation, relevant videos.	Class test (Short Q and MCQ), assignment
CLO1, CLO4	Signal Transduction and its role in drug design.	White board, PPT presentation, self-study and case study.	Quiz, written test and problem identification & solution.

ASSESSMENT PATTERN:
CIE- Continuous Internal Evaluation (40 Marks):

Bloom's Category Marks (out of 40)	Tests (20)	Assignments (10)	Quizzes/ Presentation (5)	External Participation in Curricular/Co-Curricular Activities (0)
Remember	8		1	
Understand	5	3	2	
Apply	4	4	1	
Analyze	2	2	1	
Evaluate	1	1		
Create				

*Attendance 5

SEE- Semester End Examination (60 Marks):

Bloom's Category	TEST (60)
Remember	20
Understand	18
Apply	6
Analyze	6
Evaluate	5
Create	5

Course Code: PHARM 4204 Course Title: Pharmaceutics- III Lab
Marks: 100 Credits: 02

Rationale: This course is rationale for undergraduate students. The purpose of this course is to demonstrate the student's laboratory concept about formulation, preparation and evaluation of different pharmaceutical dosages forms; solid, semisolid and liquid dosage forms.

Objectives:

- Tomake capable of students to formulate and determine quality of paraffin ointment b.p. (50 gm), paracetamol suspension (50 ml), chlorpheniramine maleate solution (100 ml), cotrimoxazole suspension, iron syrup (100 ml).
- Tocreate practical knowledge among students on preparation of paracetamol tablet and whitfield's ointment.

Course Learning Outcomes (CLOs): At the end of this course, the students will be able to-

CLO1	Develop skills on preparation of paraffin ointment, suspension, and solution.

CLO2	Facilitate necessary knowledge about preparation and evaluation of tablet.
CLO3	Apply the knowledge of preparation and evaluation of suspension.
CLO4	Enhance the skill on preparation and evaluation of syrup.
CLO5	Acquire knowledge formulation and preparation of ointment.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	3			2		1			
CLO2	2	3			2		1			
CLO3	2	3			2		1			
CLO4	2	3			2		1			
CLO5	2	3			2		1			

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Content**	**Hrs**	**CLOs**
01	Preparation of paraffin ointment B.P. (50 gm).	8	CLO1
02	Formulation and preparation of paracetamol suspension (50 ml).	8	CLO1
03	Formulation and preparation of chlorpheniramine maleate solution (100 ml).	8	CLO1
04	Formulation and preparation of paracetamol tablet.	8	CLO2
05	Formulation and preparation of cotrimoxazole suspension.	8	CLO3
06	Formulation and preparation of iron syrup (100 ml).	8	CLO4
07	Formulation and preparation of Whitfield's ointment	8	CLO5

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

(CLOs)	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO2	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO3	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO4	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments
CLO5	Lecture and Lab experiments.	Written test and drawing conclusions of the experiments

Text Book:

1. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy

Reference Books:

1. E. A. Rawlins : Bentley's Textbook of Pharmaceutics
2. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students
3. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design
4. H. C. Ansel and N. G. Popovich : Pharmaceutical Dosage Forms and Drug Delivery Systems
5. Randy Hendrickson et. al. : Remington, The Science and Practice of Pharmacy

Course Code: PHARM 4205Course Title: Pharmacology-III- Lab
Marks: 100 Credits: 02

Rationale: To acquire practical knowledge on different methods of determining various pharmacologic effects.

Objective:

- To provide practical knowledge and observe the effects of various types of drugs on biological system.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To handle the experimental animals like mice and rat.
CLO2	To gain practical knowledge about the estimation of glucose, aspirin, paracetamol and protein in blood by various methods.
CLO3	To gain practical knowledge about the estimation of NSAIDs, anesthetics in blood by various methods.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3			3	3				
CLO2	3	3			3	3				

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course Contents**	**Hrs**	**CLOs**
1.	Estimation of aspirin in blood after oral administration by UV spectrophotometric method.	4	CLO1
2.	Estimation of aspirin in blood after oral administration by colorimetric method.	4	CLO1
3.	Estimation of paracetamol in blood after oral administration by UV/Visible spectrophotometric method.	4	CLO1

4.	Determination of paracetamol in blood by colorometric method.	4	CLO1
5.	Estimation of indometacin in human blood by spectrophotometric method.	4	CLO2
6.	Toxicity test of the drugs like phenobarbitone, nikethamide, some antineoplastic drugs, pilocarpine, etc	4	CLO1
7.	Biological assay of digitalis, histamine and insulin.	4	CLO1
8.	Microbiological assay of antibiotics and vitamins.	4	CLO3

Text Book:

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

Reference Books:

1. H. P. Rang, M. M. Dale: Pharmacology
2. K. D. Tripathi: Essentials of Medical Pharmacology
3. R. A. Harvey, P. C. Champe: Lipponcott's Illustrated Reviews Pharmacology
4. Andres Goth: Medical Pharmacology
5. B. G. Katzung: Basic and Clinical Pharmacology
6. R. S. Satoskar and Bhandarkar: Pharmacology and Pharmacotherapeutics Vol. I & II

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1	Estimation of aspirin in blood after oral administration by UV spectrophotometric method.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Estimation of aspirin in blood after oral administration by colorimetric method.	Written test, Quiz, Collecting data through observation and experimentation.
CLO1	Estimation of paracetamol in blood after oral administration by UV/Visible spectrophotometric method.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Determination of paracetamol in blood by colorometric method.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO2	Estimation of indometacin in human blood by spectrophotometric method.	Written test, Quiz, Collecting data through observation and experimentation.

CLO1	Toxicity test of the drugs like phenobarbitone, nikethamide, some antineoplastic drugs, pilocarpine, etc	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO1	Biological assay of digitalis, histamine and insulin.	Written test, Collecting data through observation and experimentation and drawing conclusions of the experiments.
CLO3	Microbiological assay of antibiotics and vitamins.	Written test, Quiz, Collecting data through observation and experimentation.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (20 Marks)

Bloom's Category Marks (out of 15)	**Lab Performance Test (10)**	**Lab reports (05)**	**External Participation in Curricular/Co-Curricular Activities (0)**
Remember	1.5	2.5	
Understand	1	2.5	
Apply	1.5		
Analyze	1		
Evaluate	2.5		
Create	2.5		

*Lab Attendance 05

SEE- Semester End Examination (30 Marks)

Bloom's Category	**TEST (25)**	**Viva Voce (05)**
Remember	2.5	1
Understand	2.5	1
Apply	2.5	1
Analyze	2.5	1
Evaluate	7.5	1
Create	7.5	

Course Code: PHARM 4206 Title: Research Project
Marks: 100 Credits: 03

Rationale: This course is designed to demonstrate a clear understanding about practical experiences to formulate research hypothesis, research design, data collection and analysis.

Objectives:

- To involve the students in research activity.
- To nourish the students talent/skill for being a good researcher.

- To develop skills for doing research in different fields of pharmacy.
- To learn how to write a report, research article & their publication in renowned journals.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	To independently make hypothesis, design experiment, interpret the result, and write research report.
CLO2	To be trained up how to present and publish their research results in a scientific journal.
CLO3	To preparing a research proposal and research project for research grant, which is very important to be a good researcher.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	2			3					
CLO2	3	2			2					
CLO3	3	2			3					

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course contents**	**Hrs**	**CLOs**
01	Students will submit a project report on particular topic under the supervision of a faculty member in the Department. Students will have to present their project works before the examination committee.	42	CLO1 CLO2 CLO3

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1 CLO2 CLO3	Basic concept and general discussion on clinical research	White board, PPT presentation, Field work, Literature survey, reading published articles	Report writing, presentation, viva and performance

Learning Materials:

Relevant journals and books/book chapter of the renowned publisher such as-

1. ACS Publisher
2. Cell Press

3. Elsevier Publisher
4. MDPI
5. SAGE Publisher
6. Springer Publisher
7. Taylor and Francis Publisher
8. Wiley

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (100 Marks):

Bloom's Category Marks (out of 30)	**Report writing (50)**	**Presentation (30)**	**Performance (20)**	**External Participation in Curricular/Co-Curricular Activities**
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				

*Class Attendance 10

SEE- Semester End Examination (00 Marks)

Bloom's Category	TEST (00)
Remember	
Understand	
Apply	
Analyze	
Evaluate	

Course Code: PHARM 4207 Title: In-plant Training
Marks: 50 Credits: 02

Rationale: This course is designed to gain practical knowledge about the drug product manufacturing processes in the industry.

Objectives:

- To collaborate theoretical knowledge of industrial pharmacy with practical knowledge.
- To gather better knowledge on drug manufacturing, quality control operations.
- To develop their skills for developing carrier in pharmaceutical industry.
- To expose the students to actual working environment.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Develop their skills and get industrial knowledge which will help you to understand what is actually happens in industry
CLO2	See the manufacturing process and quality control test of pharmaceutical products
CLO3	Expose students to real work of environment experience and at the same time, to gain the knowledge through hands on observation and job execution.
CLO4	Develop skills in work ethics, communication, management and others.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3	3	1		3				1	
CLO2	3	3	1		2				1	
CLO3	3	3	1		3				1	
CLO4		3	1						1	

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No.	**Course contents**	**Hrs**	**CLOs**
01	The students will undergo in-plant training in a recognized pharmaceutical industry. After completion of the training, students will submit a report and give an oral presentation in the department.	42	CLO1 CLO2 CLO3 CLO4

Text Book:

1. Leon Lachman. The Theory And Practice Of Industrial Pharmacy. 3rd Edition, 1986; Lippincott Williams & Wilkins.
2. Geoffrey D. Tovey. Pharmaceutical Formulation: The Science and Technology of Dosage Forms. 2018; Royal Society of Chemistry.
3. Michael E. Aulton, Kevin M. G. Taylor. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. 4th Edition, 2013; Elsevier.
4. Loyd V. Allen Jr., Howard C. Ansel. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 10th Edition, 2013; Wolters Kluwer Health.

Reference Books:

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2. Joachim Ermer, Phil W. Nethercote. Method Validation in Pharmaceutical Analysis: A Guide to Best Practice. 2nd Edition, 2014; Wiley-VCH.
3. Paul J. Sheskey, Walter G. Cook, Colin G. Cable. Handbook of Pharmaceutical Excipients. 8th Edition, 2017; Pharmaceutical Press.

4. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook Production and Processes. 2008; Wiley.

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**
CLO1 CLO2 CLO3 CLO4	Practical training on drug manufacturing processes	White board, PPT presentation, visit physically different areas of the industry	Report writing, presentation, viva and performance

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (100 Marks):

Bloom's Category Marks (out of 30)	**Report writing (50)**	**Presentation (30)**	**Performance (20)**	**External Participation in Curricular/Co-Curricular Activities**
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				

*Class Attendance 10

SEE- Semester End Examination (00 Marks)

Bloom's Category	TEST (00)
Remember	
Understand	
Apply	
Analyze	
Evaluate	

Course Code: PHARM 4208 Title: Hospital Internship
Marks: 50 Credits: 02

Rationale: This course is designed to understand the role of pharmacist in a hospital as well as to acquire practical knowledge about patient care in hospital and community clinic.

Objectives:

- To understand the importance of hospital pharmacist for the safe & effective use of medicine.
- To explore their knowledge about emerging diseases & their treatment.
- To get knowledge about the necessity of community pharmacy in the society.
- To get acquainted with prescriptions handing in a healthcare setting.
- To develop their skills for being a hospital pharmacist in home & abroad.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Acquire the practical knowledge on the role of hospital and clinical pharmacist in a hospital.
CLO2	Understand prescription, drug-drug interactions and adverse drug reactions.
CLO3	Evaluate the prescriptions and select best possible medications for the patients.
CLO4	Ensure procurement, storage, dispensing and proper use of medicines in the hospital.
CLO5	Monitor and control of narcotics as well as other restricted drugs.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	2	2	1		3	3			1	
CLO2	2	2	1		2	3			1	
CLO3	2	2	1		3	3			1	
CLO4	1	2	1			3			1	
CLO5	1	2	1			3			1	

(Level of correlation: 3-High, 2-Medium, 1-Low)

SL No	**Course contents**	**Hrs**	**CLOs**
01	Students must go through hospital training for around one month in one or more authorized hospital(s)/clinic(s). Hospital/Clinic authority will arrange their visit in each unit of their organization and will give training about how to manage patients in different critical conditions, rational use of drugs, prevention of diseases, etc. After completion of the training, students will submit a report and give an oral presentation in the department.	42	CLO1 CLO2 CLO3

Mapping Course Learning Outcomes (CLOs) with the Teaching-Learning& Assessment Strategy:

CLOs	**Topic**	**Teaching-Learning Strategies**	**Assessment Strategies**

CLO1 CLO2 CLO3 CLO4 CLO5	Role of pharmacist in patient care in the hospital	White board, PPT presentation, Conversation with doctors, patients, visit physically different words in the hospital.	Report writing, presentation, viva and performance.

ASSESSMENT PATTERN:

CIE- Continuous Internal Evaluation (100 Marks):

Bloom's Category Marks (out of 30)	**Report writing (50)**	**Presentation (30)**	**Performance (20)**	**External Participation in Curricular/Co-Curricular Activities**
Remember				
Understand				
Apply				
Analyze				
Evaluate				
Create				

*Class Attendance 10

SEE- Semester End Examination (00 Marks)

Bloom's Category	TEST (00)
Remember	
Understand	
Apply	
Analyze	
Evaluate	

Course Code: PHARM 4209 Title: Viva voce-IV
Marks: 50 Credits: 1

Rationale: The viva voce at the end of each year is designed to assess the ability of the student to express their understanding of their yearlong classwork in front of a jury board.

Objective: This course gives a glimpse of interview board to assist the students to prepare themselves for prospective viva boards for job or higher studies.

Course Learning Outcomes (CLOs): at the end of the course, the student will be able to-

CLO1	Learn how to approach themselves before an interview board.
CLO2	Overcome the fear or nervousness of facing face to face interview or interaction.
CLO3	Present their concepts systematically in oral form.
CLO4	Prepare them for future job interview.

Mapping of Course Learning Outcomes (CLOs) to Program Learning Outcomes (PLOs):

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**
CLO1	3								2	
CLO2	3								2	
CLO3	3									
CLO4									3	

SL NO	**Course content**	**Hrs**	**CLOs**
1.	Topics of viva voce will encompass all the theory and sessional courses conducted throughout the entire fourth year including semester I and semester II.	-	CLO1 CLO2 CLO3 CLO4

Text Book:

4. All books relevant to courses studied during fourth year first and second semester.

Reference books:

7. Marc Dorio. Complete Idiot's Guide to the Perfect Interview. 2nd edition, 2000; Alpha Books.
8. Susan Hodgson. Brilliant Answers to Tough Interview Questions. 5th edition, 2015; FT Press

PART D

1. **Teaching- Learning Strategy:**

   Teaching learning strategy refers to the immediate performance of the learners in relation to specific instruction under certain method and level of accuracy. The following teaching method used by the course teacher: Recommended text books including web-based materials, lecture sheet, Class discussion, recitation oral question answer session, case study, presentation each chapter in the course by the student, problem-based learning and solving, Group work, field visit, Individual work, assignment, multimedia projector used for lecture and example cooperative learning, Debate on current issues.

2. **Assessment Strategy:**

   Students can also assess their own work in the class, midterm, assignment and their assessment can be a portion of the final grade. This method has educational value as learning to assess one's own progress contributes to the university's goal of preparing our students to be life-long learners.

Evaluation of the student in this course as follows:

Process of evaluation	**Marks**
Class attendance	5%
Assignment and Quiz-test	5%
Term paper presentation	10%
Two mid-term examination (10X2)	20%
Final examination	60%
Total	**100%**

Grading policy of the total 100 marks on the above evaluation process awarded by the semester:

Marks Range	**Letter Grade**	**Grade Point**	**Interpretation**
80+	A+	4.00	Outstanding
75-79	A	3.75	Excellent
70-74	A-	3.50	Very Good
65-69	B+	3.25	Good
60-64	B	3.00	Average
55-59	B-	2.75	Below Average
50-54	C+	2.50	Fair
45-49	C	2.25	Poor

40-44	D	2.00	Minimum Pass
Below 40	F	0	Fail
----------	I	--------	Incomplete
----------	W	--------	Withdrawn

Class Year	**Number of Courses**		**Total Course Units**	**Credit Hours**
	First Semester	**Second Semester**		
Course Works				
First Year	06	05	11	32
Second Year	06	05	11	31
Third Year	08	06	13	40
Fourth Year	08	06	14	38
Viva-Voce and Internship/Project Paper				
Viva-Voce				09
Project Report				03
TOTAL				153

Medium of Instruction

The medium of instruction of the program of different academic faculties shall be English and /or Bangla. The Academic Committee of the concerned department shall have the right to decide the medium of instruction.

Examination Entry Requirements

A student will be allowed to take part in Semester Final Examination if s/he fulfills the following conditions:

a. If the student has registered for the concerned semester in due time.

b. If s/he has the required percentage of attendance in each course lecture.

c. If the student has paid all dues (registration fees/tuition fees/other charges) applicable to university administration/residential hall administration/discipline administration.

d. If the student has not been instructed by the Disciplinary Board / Examination Disciplinary Committee to refrain from taking part in the examination.

Evaluation System

a. Theoretical Course: Each theoretical course offered should be composed of either 50 or 100 marks (each 50 marks course consisting of 2 credit point). The proportion of the total marks of a particular course shall be distributed as follows:

Continuous Assessment /Before-Final Assessment	40%
Semester-Final Examination	60%
Total =	100%

b. Continuous Assessment: Marks allocated for before-final assessment shall be distributed as follows:

i. **Internal Evolution:**

a) Mid-Semester examination (At least Two mid-semester exams.) 20%

b) Class Test and/or Quiz and/or In-course and/or Sudden test and/or tutorial and/or Assignment and/or Term paper preparation & presentation/ Case study and/or practical and/or Field work [1] 15%

Class Attendance	5%
Total =	40%

ii. **Class Attendance:**The marks allocated for class attendance shall be given as following proportions:

Attendance	Marks
90% and above	100%
85% to less than 90%	90%
80% to less than 85%	80%
75% to less than 80%	70%
70% to less than 75%	60%
65% to less than 70%	50%
60% to less than 65%	40%
Less than 60%	00%

[1] Concerned department and/or course teacher will decide the allocation of this mark in different activities.

iii. **Before-final Assessment Report:**

- At the end of the course, the course teacher shall calculate the total marks of the continuous assessment (including class attendance) and prepare a marks sheet. The answer scripts of the mid-term examinations should be shown to the students as it is valuable for their learning process. The before-final assessment marks have to be submitted to the Controller of the Examinations before the suspension of class for the semester final examinations.
- The course teacher shall also submit the class attendance marks along with the register/documents to the Chairman of the Department. The chairman will take into consideration the attendance mark while forwarding the examination entry forms to the Controller of the Examinations.

c. Class-Attendance Requirements to Appear in the Semester Final Examination:

i. If class attendance of any student at any course is below 60%, but in the range of 40% to 59%, s/he will be allowed to attend the examination only with the recommendation of the course teacher and approval of the chairman of the department. In such cases the student will have to pay a fine as fixed by the authority/department.

ii. A student with class attendance of less than 40% in any course will be debarred from appearing in the Final Examination.

b. Letter Grade and Grade point: Total marks obtained in each course, oral (viva-voce) examination and practical courses shall be converted into LG (Letter Grade) and GP (Grade point) as follows:

Numerical Grade	**Letter Grade**		**Grade point**	**Interpretation**
80% and above	A+	(A Plus)	4.00	Outstanding
75% to less than 80%	A	(A regular)	3.75	Excellent
70% to less than 75%	A-	(A minus)	3.50	Very Good
65% to less than 70%	B+	(B Plus)	3.25	Good
60% to less than 65%	B	(B regular)	3.00	Satisfactory
55% to less than 60%	B-	(B minus)	2.75	Below Satisfactory
50% to less than 55%	C+	(C Plus)	2.50	Average
45% to less than 50%	C	(C regular)	2.25	Pass

40% to less than 45%	D	.....	2.00	Poor
Less than 40%	F	.....	0.00	Fail

* In the Transcript/Grade sheet, only the Letter Grade and the Corresponding Grade points, and final CGPA (in the 8th Semester), not the numerical marks, will be shown.

Promotion[2]

a. For promotion from one semester to the next class tear a student is required to earn minimum CGPA of 2.00 in each class year on condition that s/he has passed the viva-voce.

b. If anybody is absent from the viva-voce on any valid ground a viva-voce may be arranged for him/her on condition that s/he will bear all expenses of the viva. In such case s/he has to apply to chairman of the department within 15 days after the viva-voce exam.

Degree requirements

a. For Bachelor (Honors) degree/BBA degree, a student requires to:

i. Earn required number of total credit points successfully;
ii. Earn a minimum CGPA of 2.25; and
iii. Complete the program within six academic years from her/his 1st admission to the program.

b. Award of (Pass) Degree:

i. A student who fails to secure a minimum CGPA of 2.25 after completing eighth semester final examination but succeeds in securing a CGPA between 2.00 and 2.25 will be eligible for a Pass Degree.

Improvement of grades

Only the removal of 'F' (Fail) in any course shall be allowed. Removal of 'F' in any course is permitted sitting in the final examination only for two (2) times in subsequent two semesters excluding the regular examination. In such cases results shall be one grade down (unless the result is a "D" grade) in tabulation and calculation of CGPA.

Dc‡iv³ cix¶vwewai ¯'‡j 2011-2012 wk¶vel© †_‡K wb‡gœv³ wewaKwgwU KZ…©K mycvwikKivn‡jv- 32Zg GKv‡WwgKKvDwÝjmfvim¤ú~iK- 8 Gi mycvwik

Improvement of grades

[2] For the session 2006-07 to 2010-11 the promotion rule is different and is attached in Annex-1 .

i. A student having earned 'F' grade in any course in any semester shall be required to remove the 'F' grade. Removal of 'F' grade in any course is permitted only for two (2) times excluding the regular examination. This has to be done within his academic tenure.

ii. A student having earned letter grade **'B-' (GP- 2.75)** or below in any course may be allowed to improve the grade by appearing in the semester-final examination with the next available batch[3]. S/he can avail this opportunity only once for a course. In such case the best GPA from the improvement or regular examination/concern subject shall be calculated for tabulation. In such cases results shall be one grade down (unless the result is a 'D' grade) in tabulation calculation of CGPA.

iii. A student having earned 'F' grade in any course in any semester shall be required to remove the 'F' grade. Removal of 'F' grade in any course is permitted only for two (2) times excluding the regular examination. Which has to be done with subsequent available batches.

iv. A student having earned letter grade **'B-' (GP- 2.75)** or below in any course may be allowed to improve the grade by appearing in the semester-final examination with the next available batch[2]. S/he can avail this opportunity only once for a course. In such case the best GPA from the improvement or regular examination/concern subject shall be calculated for tabulation.

v. A student willing to improve grade should apply to the controller of examination through the chairman of the department within 01 (one) week after the publication of the results of the semester.

vi. No improvement shall be allowed in continuous assessment (mid-term/class-test/assignment/ fieldwork/ monograph/ project/ practical/case-study/term-paper/quiz test/etc.).

vii. The concerned (current) examination committee to that semester will take necessary actions to arrange the improvement examinations, tabulation and posting of marks.

* If a student gets one month after his result publication to sit for the examination with a batch that batch will be considered as available batch for her/his.

Re-admission

a. A student failing to earn the requisite credit points for promotion (clause 10) from one semester to the next may seek readmission with the following batch.

b. For readmission a student shall have to apply within one month after the announcement of the result of the concerned semester.

Drop out

a. If a student re-admitted twice in any semester fails to earn minimum required credits [4] for promotion shall be dropped out from the program.

b. If a student fails to earn required total credit points within six academic years since admissions, s/he will be dropped-out from the program and will no more be allowed to continue his/her studentship with other programs.

Credit transfer

No Credit transfer from any other program /University /Institutions to the Comilla University is allowed.

Promotion

a. Promotion will be declared on academic year basis.

b. For promotion from one class year to next class year, a student is required to earn minimum CGPA of 2.00 in each class year. (**28 ZgGKv‡WwgKKvDwÝjms‡hvRbon condition that s/he has passed the Viva-voce.)**

Improvement of grades

viii. Student who did not get the opportunity of removing 'F' in any course as per rule 12(i) shall be allowed to sit for a special semester examination. This will be allowed only for the course in 7th and 8th semester. In special cases this opportunity would be allowed for courses in semester 5th and 6th. In such cases student have to apply to the Chairman of the department within one week after publication of the 8th semester result. The Chairman of department shall take necessary administrative measures for arranging the special semester examinations by the respective 4th year examinations committee. All the expenses relating to this examination have to be carried by the candidate(s).

ix. A student having earned letter grade of less than 'B' (less than GP 3.00) in any course may be allowed to improve the grade by appearing in the semester-final examination with the next available batch[5]. S/he can avail this opportunity only once for a course.

x. No improvement will be allowed in 8th semester.

xi. For appearing in the improvement examination, a student shall have to pay fees for the course prescribed for the purpose.

[4] For the session 2006-07 to 2010-11 'the minimum required CGPA in each class year'.

[5] If a student gets one month after his result publication to sit for the examination with a batch that batch will be considered as available batch for her/his.

xii. A student willing to improve grade should apply to the controller of examination through the chairman of the department within 01 (one) week after the publication of the results of the semester.

xiii. No improvement shall be allowed in continuous assessment (mid-term/class-test/ assignment/ fieldwork/ monograph/ project/ practical/ case-study/ term-paper/ quiz test/etc.).

xiv. The concerned (current) for that semester will take necessary actions to arrange the improvement examinations, tabulation and posting the marks.

Annex-2 : Rules regarding Examination Offences and Disciplinary Action

Formation of Examination Disciplinary Committee:

1. Disciplinary action against candidates involved in Examination offences shall be taken by the Syndicate on recommendation of the Examination Discipline Committee as constituted below:

(i)	The Vice-Chancellor	Chairman
(ii)	The Deans of the Faculties	Members
(iii)	Two provosts to be nominated by the Vice-Chancellor	Members
(iv)	Three teachers of the University to be nominated by the Vice-Chancellor	Members
(v)	Two Chairman be nominated by Vice-Chancellor	Members
(vi)	Proctor	Member
(vii)	The Controller of Examinations	Members-Secretary

2. Members other than Vice-Chancellor members shall hold office for a period of one year after formation of the committee.
3. Five members shall form the quorum
4. The following shall be considered Examination offences:

(a) Communication or attempt to communicate with any other candidate intheExamination Hall.

(b) Writing in the Examination Hall anything incriminating on the question paper or admit card, table, desk, bench, etc.

(c) Possession of incriminating notes, books, map, chart, slip, chit or any other documents, in the examination hall.

(d) Creating or inciting to create any nuisance or disturbance in the Examination Hall.

(e) Copying or attempt to copy from incriminating documents or from another's script, or from any writing on the person or wearing apparel while appearing at the Examination.

(f) Taking the script out of the Examination Hall.

(g) Changing the script or inserting unauthorized sheets in the script.

(h) Approaching or influencing the Invigilator, Examiners, or members of the Examination Committee, Tabulators to gain undue favor or advantage in connection with Examination.

(i) Using abusive language or holding out threat to the invigilator or any other person engaged on Examination duty inside or outside the Examination Hall.

(j) Assault or attempt to assault or use criminal force against Chief Invigilator or the Invigilator or any other person engaged on Examination duty inside or outside the Examination Hall.

5. In making its recommendation, the Examination Discipline Committee shall follow the following rules.

(a) Candidates found guilty of offence or offences falling under Section 4 (a), (b) and (c) shall be penalized with the cancellation of the Examination at which they commit offence or offences.

(b) Candidates found guilty of offence falling under Section 4(d) shall in addition to cancellation of the Examination at which the offence is committed, be debarred from appearing at the subsequent Examination.

(c) Candidates found guilty of offences falling under Section 4(e), (f), (g) and (h) shall, in addition to the cancellation of the Examination at which the offence is committed, be debarred from appearing at two or three subsequent Examinations or from that semester depending on the gravity of the offence.

(d) Candidates found guilty of offence falling under Section 4 (i) and (j) shall, in addition to the cancellation of the Examination at which the offence is committed, be debarred from appearing at the subsequent Examinations of the one or two semesters depending on the gravity of the offence.

6. Any other offence not covered by the above rules shall be dealt with by the Syndicate on the recommendation of the Examination Discipline Committee as it deems fit.

7. Candidates committing offences except those falling under Section 4 (a), (b), (c), (d), (e) and (i) shall not be allowed to continue to appear in that paper, and their scripts shall not be sent for evaluation but shall be sent separately to the Controller of Examinations in sealed cover.

8. The Invigilator shall submit separate report for each case, regarding the nature of the offence and the circumstances in which it is alleged to have been committed, with all supporting documents underlining the coped portion in the script as well as in the incriminating documents in the case of actual copying.

9. The Chief Invigilator of the Examination Center shall forward the report of the Invigilators and relevant documents with his expressed opinion along with the script. These reports and documents will be preserved by the Controller of Examinations for a period of at least six months from the date of the publication of the penalty list.

10. The following procedure shall be adopted in dealing with cases of candidates involved in Examination offences:

(i) On receipt of reports from the Chief Invigilator of the Examination Center, the Controller of Examinations shall call for explanation from the candidate concerned asking him why disciplinary action shall not be taken against him for the alleged committed of examination offence. Such show-cause notice must be sent by registered post to his permanent address as recorded in the Examination Entry Form registration form. The candidate must be given ten days' time from the date of issue of show-cause notice to submit his explanation. If no explanation is received within the prescribed time limit, the Examination Disciplinary Committee may take necessary disciplinary action.

(ii) The controller of Examinations will then place all relevant documents of the case together with the explanation of the candidate to the Examination Discipline Committee for consideration. The proceedings of the Discipline Committee shall be forwarded to the registrar for reporting it before the Syndicate.

11. Provided that in any emergency, notwithstanding the provisions of the Rules and Regulations on the subject, the Vice-Chancellor may in exercise of the powers vested in him in terms of clause (j) of Section 11 [of the Comilla University Act, 2006; take any disciplinary action considered necessary in the circumstances and report the same to the Syndicate for information.

Annex-5: Computation of Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

The GPA and CGPA will be computed in following formula:

$$GPA = \frac{\Sigma \text{ (Credit} \times \text{Grade Points Secured)}}{\text{Total Credits Offered in the Semester}^{6}}$$

$$CGPA = \frac{\Sigma \text{ (Credit} \times \text{Grade Points Secured)}}{\text{Total Number of Credits offered in the whole program}}$$

Dean's Honor list, Dean's Merit list and Honor Society

Students who have earned GPA of 4.00 in any semester shall be included in the Dean's Merit list of the semester. Students securing a CGPA of at least 3.90 shall be included in the Dean's Honor list of the year.

Calculation of Cumulative Grade Point Average (CGPA)

Example:

First Year First Semester

Course	(1)	(2)	(3)	(4) = (1) × (3)
	No. of Credits	**Grade Awarded**	**Total Grade Points**	**Grade Points Secured**
Stat-111	3	B	3.00	9.00
Stat-112	3	A+	4.00	12.00
Stat-113	3	D	2.00	6.00
Stat-114	3	A	3.75	11.25
Stat-115	3	A–	3.50	10.50
Stat-116	3	A	3.75	11.25
Total	**18**			**60.00**

[6] For Session 2006-07 to 2010-11 'Total Credits offered in the Year'.

SGPA = Total Grade Points Secured ÷ Total Number of Credits = 60.00 ÷ 18 = 3.33

First Year Second Semester

Course	(1)	(2)	(3)	(4) = (1) × (3)
	No. of Credits	**Grade Awarded**	**Total Grade Points**	**Grade Points Secured**
Stat-121	3	B	3.00	9.00
Stat-122	3	C+	2.50	7.50
Stat-123	3	D	2.00	6.00
Stat-124	3	A	3.75	11.25
Stat-125	3	A+	4.00	12.00
Viva-voce	2	A	3.75	7.50
Total	**17**			**53.25**

SGPA = Total Grade Points Secured ÷ Total Number of Credits = 53.25 ÷ 17 = 3.13

Cumulative Data:

Total Credit = (18+ 17) = 35

Total Grade Points Secured = (**60.00**+ **53.25**) = 113.25

Cumulative Grade Point Average (CGPA) = 113.25 ÷ 35 = 3.24

Comilla University

Faculty of Science

Department of Pharmacy

OBE Curriculum of B. Pharm
Academic Session: 2023-2024, 2024-2025, and 2025-2026

Particulars	**Credits**
Courses – 38 Courses	111
Pharmacy Lab -22 Courses	41
Viva voce	4
Research Project	3
Pharmaceutical In-plant Training	2
Hospital Internship	3
Total	**160**

Pharmacy Alumni Association
Convener Committee

SL.	**Name**	**Designation**
01	Md. Saddam Hossain	Convener
02	Joynta Mazumder	Member
03	Md. Ashraful Rahman Bhuiyan	Member
04	Kawsar Hamid	Member
05	Meherun Nesa	Member
06	Md. Shajalal Reza	Member
07	Akil Mahmud	Member Secretary