UNIVERSITY OF THE PUNJAB

NOTIFICATION

The Syndicate at its meeting held on 01.01.2026 approved the recommendations of the Academic Council made at its meeting dated 16.12.2025 regarding revised Curriculum and Rules for Doctor of Pharmacy (Pharm. D.) 5 years degree program under Semester System to be offered at University of the Punjab and its Affiliated Colleges from Academic Year 2025 (Fall Semester) in the light of HEC's guidelines.

The revised syllabi & course of reading of Doctor of Pharmacy (Pharm. D.) 5 years degree program 1st and 2nd semester under Semester System from Academic Year 2025 are attached. However, the revised syllabi & course of reading of Doctor of Pharmacy (Pharm. D.) 5 years degree program for remaining semesters shall be provided in due course of time.

Sd/-
Dr. Ahmad Islam
Registrar

Admin. Block,
Quaid-i-Azam Campus,
Lahore.
No. D/2001/Acad.

Dated: 27/04/2026.

Copy of the above is forwarded to the following for information and necessary action: -

1. Dean, Faculty of Pharmacy
2. Principal, Punjab University College of Pharmacy
3. Principal, Affiliated Colleges
4. Controller of Examinations
5. Director, IT for placement of syllabus at website
6. Additional Registrar (Affiliation) for informing Affiliated Colleges
7. Secretary to the Vice-Chancellor
8. Private Secretary to PVC
9. Private Secretary to the Registrar
10. Assistant Registrar (Statutes Section)
11. Assistant Registrar (Syllabus)

Registrar
University of the Punjab

Program Curriculum

Pharm.D

Punjab University College of Pharmacy
University of the Punjab
Lahore

Programme	Pharm.D				
Duration	5 Years	**Semesters**	10	**Credit hours**	195 - 210
Department	Punjab University College of Pharmacy				
Faculty	Faculty of Pharmacy				

Department Introduction

The Department of Pharmacy was established in the subcontinent in 1944 at King Edward Medical College, Lahore. After the creation of Pakistan, the department was shifted to the University of the Punjab in 1948. In 1979, the University upgraded the department to the level of a faculty. Since then, the faculty has experienced continuous progress in teaching, research facilities, and student intake. At present, the Faculty of Pharmacy consists of two institutions: the Punjab University College of Pharmacy and the Department of Natural Medicine. In accordance with the directives of the Pakistan Pharmacy Council, the Punjab University College of Pharmacy is organized into five independent sections: Pharmaceutics, Pharmaceutical Chemistry, Pharmacology, Pharmacognosy, and Pharmacy Practice. The College has the necessary infrastructure to offer quality pharmacy education and research opportunities at both undergraduate and postgraduate levels. It also houses a well-equipped library with more than 20,000 subject-specific books. The college aims to strengthen the initiatives taken so far, to promote entrepreneurship, and enhance public–private partnerships for community pharmacy. Furthermore, we will educate and equip our students to effectively contribute to both local and international healthcare systems.

Department Vision

To be a center of excellence in pharmacy education and research, producing competent and innovative pharmacists who contribute to the advancement of healthcare at national and international levels.

Department Mission

The Punjab University College of Pharmacy is committed to producing competent pharmacists who can excel in all areas of the pharmacy profession, contribute to health policy development, and promote national and international collaborative research aimed at sustainable growth, as well as the availability and affordability of medicines for the ailing community.

Department Goals

1. Provide quality pharmacy education
2. Develop skilled and innovative pharmacists
3. Promote research and innovation
4. Strengthen clinical and professional pharmacy practice
5. Encourage national and international collaborations
6. Support entrepreneurship and leadership in pharmacy
7. Contribute to societal health and wellbeing

Program Introduction

The five-year 'Doctor of Pharmacy' program provides students with a comprehensive foundation in pharmaceutical sciences and clinical practice. The HEC-2025 curriculum is designed to build expertise in the core areas of Pharmaceutics, Pharmacology, Pharmaceutical Chemistry, Pharmacognosy, and Pharmacy Practice. Additionally, courses in Basic Medical Sciences provide a strong understanding of human anatomy, physiology, and pathology, forming the basis for effective healthcare delivery.

The program integrates these foundational sciences with advanced training in Pharmacy Practice, ensuring students develop the clinical skills needed for patient-centered care. Through practical experiences such as hospital rotations, community pharmacy internships, and case-based learning, students gain real-world exposure to medication management, patient counselling, and healthcare collaboration. This blend of theoretical knowledge and hands-on practice equips graduates to excel in diverse pharmacy roles, from clinical and hospital pharmacy to research, regulatory affairs, and pharmaceutical industry positions. The program's multidisciplinary approach fosters innovation, ethical practice, and lifelong learning, preparing graduates to contribute meaningfully to the advancement of healthcare. The program emphasizes critical thinking, ethical practice, and effective communication, ensuring graduates are prepared to play a key role in improving patient outcomes. Graduates of the Pharm. D. program are well-positioned to work in hospitals, community pharmacies, pharmaceutical industries, regulatory agencies, government departments, non-governmental organizations, various disease control programs, international health organizations, become entrepreneurs, and pursue further specialization. The curriculum is structured to not only meet national and international standards but also instill a commitment to lifelong learning, ensuring that graduates remain at the forefront of advancements in pharmacy and healthcare.

Program Objectives

1. Provide strong foundational knowledge
2. Develop clinical competence
3. Strengthen professional pharmacy practice
4. Enhance research and analytical skills
5. Prepare industry-ready professionals
6. Develop leadership, communication & entrepreneurial skills
7. Promote regulatory awareness
8. Encourage Lifelong Learning & Professional Growth
9. Strengthen Community Service & Public Health Engagement
10. Support Career Diversity & Global Competitiveness

Market Need / Rationale of the Program

a) *Potential Students for the program*

Pharmacy remains one of the most sought-after professional programs among students interested in healthcare and pharmaceutical sciences. Many students with backgrounds in pre-medical and pre-pharmacy studies seek admission to the Pharm-D program to pursue careers in hospital pharmacy, pharmaceutical industry, research, regulatory affairs, and community pharmacy. The program offers a multidisciplinary curriculum that combines pharmaceutical sciences with clinical and patient-care training, making it attractive to students who aim to contribute to healthcare services and medicine management. The continued increase in applications for pharmacy programs in Pakistan reflects strong student interest and career motivation in this field.

b) *Potential Employers*

Graduates of the Doctor of Pharmacy (Pharm-D) program are required across various sectors of the healthcare and pharmaceutical industry. Potential employers include:

1. Public and private hospitals and healthcare institutions
2. Pharmaceutical manufacturing companies
3. Drug regulatory authorities
4. Research and development organizations
5. Community pharmacies and retail pharmacy chains
6. International health organizations and NGOs

With the rapid growth of Pakistan's pharmaceutical sector and increasing focus on clinical pharmacy services and rational drug use, the demand for qualified pharmacists continues to grow. According to the Pharmacy Council of Pakistan, pharmacists play a critical role in drug safety, patient counseling, and

pharmaceutical quality assurance. Expanding pharmaceutical industries and healthcare infrastructure indicate strong employment prospects for pharmacy graduates in the future.

c) ***Academic Projections***

Pharmacy education has been widely adopted globally as a professional healthcare program. The Doctor of Pharmacy (Pharm-D) program is offered by numerous universities worldwide including institutions in the United States, United Kingdom, Canada, and Australia. In Pakistan, many universities have adopted the Pharm-D curriculum following directives from the Higher Education Commission of Pakistan and the Pharmacy Council of Pakistan to ensure uniform professional standards. The widespread adoption of this program internationally and nationally reflects its academic relevance and necessity for modern healthcare systems.

d) ***Faculty***

The Punjab University College of Pharmacy has a qualified and experienced faculty specializing in various disciplines of pharmaceutical sciences, including pharmaceutics, pharmaceutical chemistry, pharmacology, pharmacognosy, and pharmacy practice. Faculty members possess postgraduate qualifications, research expertise, and teaching experience necessary to deliver high-quality education. The availability of specialized faculty ensures effective teaching, supervision of research activities, and professional training of students in accordance with national academic standards.

e) Physical Facilities

The College provides adequate infrastructure and resources to support the Doctor of Pharmacy (Pharm-D) program. The institution has well-equipped laboratories for pharmaceutical sciences, modern teaching facilities, and a comprehensive library with more than 20,000 specialized books and academic resources related to pharmacy and allied disciplines. These facilities support practical training, laboratory experimentation, and research activities required for professional pharmacy education.

Admission Eligibility Criteria

- **Years of Study completed:**
  Applicants must have completed Higher Secondary School Certificate (HSSC) or equivalent qualification involving 12 years of education with a pre-medical background.

- **Study Program/Subject:**

Eligible candidates must have completed F.Sc. (Pre-Medical), B.Sc. (after F.Sc. Pre-Medical), or any equivalent qualification recognized by the Inter Board Committee of Chairmen with subjects including Biology, Chemistry, and Physics/Mathematics.

- **Percentage/CGPA:**
  Applicants must obtain at least 60% cumulative marks or equivalent CGPA in the qualifying examination.

- **Entry Test:**
  Candidates are required to pass the University admission/entry test conducted by the University of the Punjab. Admission is granted on the basis of merit calculated according to the criteria approved by the University's statutory bodies.

- **Any other:**
  The Doctor of Pharmacy (Pharm-D) program consists of 10 semesters spread over five academic years, including theoretical coursework, laboratory training, and professional practice components.

Categorization of Courses as per HEC Recommendation and Difference

Semester	Courses	Category (Credit Hours)					
		Core Courses	Allied/Inter disciplinary	General education		Any Other	Semester Load
1	5	3	1	1			**18**
2	6	3	2	1			**20**
3	5	3	1	1			**18**
4	6	4		2			**19**
5	7	4		3			**20**
6	6	4		2			**20**
7	6	4		2			**20**
8	6	4		2			**19**
9	5	5					**18**
10	6	4		1		1 (Capstone Project)	**20**
PU							
HEC Guidelines							
Difference (HEC &) PU	**Nil**						

**Core: Compulsory, any other: Specialization*

Scheme of Studies / Semester-wise workload

#	Code	Course Title	Course Type	Prerequisite	Credit hours		
Semester I							
1.	PHARM-101 (Theory), PHARM-102 (Lab)	Physical Pharmacy - I	Major: Core		3+1		
2.	PHARM-103 (Theory), PHARM-104 (Lab)	Organic Chemistry - I	Major: Core		3+1		
3.	PHARM-105 (Theory), PHARM-106 (Lab)	Biochemistry - I	Major: Core		2+1		
4.	PHARM-107 (Theory), PHARM-108 (Lab)	Physiology-I	Allied/Interdisciplinary		3+1		
5.	ENG-109	Functional English *	General Education		3		
Total Credit Hours							18
Semester II							
1.	PHARM-111 (Theory), PHARM-112 (Lab)	Physical Pharmacy - II	Major: Core		3+1		
2.	PHARM-113 (Theory), PHARM-114 (Lab)	Organic Chemistry - II	Major: Core		3+1		
3.	PHARM-115 (Theory), PHARM-116 (Lab)	Biochemistry - II	Major: Core		2+1		
4.	PHARM-117 (Theory), PHARM-118 (Lab)	Anatomy & Histology	Allied/Interdisciplinary		2+1		
5.	PHARM-119 (Theory), PHARM-120 (Lab)	Physiology-II	Allied/Interdisciplinary		3+1		
6.	IS-121	Islamic Studies*	General Education		2		
Total Credit Hours							20
Semester III							
1.	PHARM-201 (Theory), PHARM-202 (Lab)	Drug Delivery Systems and Formulation Science-I	Major: Core		3+1		
2.	PHARM-203 (Theory), PHARM-204 (Lab)	Pharmacology and Therapeutics-I	Major: Core		3+1		
3.	PHARM-205 (Theory), PHARM-206 (Lab)	Pharmacognosy-(Basic I)	Major: Core		3+1		
4.	PHARM-207 (Theory), PHARM-208 (Lab)	Pathology	Allied/Interdisciplinary		2+1		
5.	PHARM-209 (Theory), PHARM-210 (Lab)	Basic Pharmaceutical Microbiology**	General Education (Natural Sciences)		2+1		
Total Credit Hours							18
Semester IV							
1.	PHARM-211 (Theory), PHARM-212 (Lab)	Drug Delivery Systems and Formulation Science-II	Major: Core		3+1		
2.	PHARM-213 (Theory), PHARM-214 (Lab)	Applied Pharmaceutical Microbiology and Immunology	Major: Core		3+1		
3.	PHARM-215 (Theory), PHARM-216 (Lab)	Pharmacology and Therapeutics-II	Major: Core		3+1		
4.	PHARM-217 (Theory), PHARM-218 (Lab)	Pharmacognosy (Basic - II)	Major: Core		3+1		
5.	PS-219	Pakistan Studies *	General Education		2		

#	Code	Course Title	Course Type	Prerequisite	Credit hours		
6.	FQ-220	Fehm-e-Quran I/Ethics-I*	General Education		1		
Total Credit Hours							19
Semester V							
1.	PHARM-301 (Theory), PHARM-302 (Lab)	Pharmacognosy (Applied)	Major: Core		3+1		
2.	PHARM-303 (Theory), PHARM-304 (Lab)	Pharmaceutical Analysis-I	Major: Core		3+1		
3.	PHARM-305 (Theory), PHARM-306 (Lab)	Pharmacology and Therapeutics-III	Major: Core		3+1		
4.	PHARM-307	Hospital and Community Pharmacy	Major: Core		2		
5.	QR-308	Quantitative Reasoning – I *	General Education		3		
6.	ICP-309	Ideology & Constitution of Pakistan *	General Education		2		
7.	FQ-310	Fehm-e-Quran II*	General Education		1		
Total Credit Hours							20
Semester VI							
1.	PHARM-311 (Theory), PHARM-312 (Lab)	Pharmacognosy (Advanced)	Major: Core		3+1		
2.	PHARM-313	Dispensing, Social & Administrative Pharmacy	Major: Core		2		
3.	PHARM-314 (Theory), PHARM-315 (Lab)	Pharmaceutical Analysis-II	Major: Core		3+1		
4.	PHARM-316 (Theory), PHARM-317 (Lab)	Pharmacology and Therapeutics-IV	Major: Core		3+1		
5.	ICT-318 (Theory), ICP-319 (Lab)	Applications of ICT (Especial focus on Pharmacy) *	General Education		2+1		
6.	QR-320	Quantitative Reasoning-II*	General Education (Contents of Biostatics added)		3		
Total Credit Hours							20
Semester VII							
1.	PHARM-401 (Theory), PHARM-402 (Lab)	Industrial Pharmacy - I	Major: Core		3+1		
2.	PHARM-403 (Theory), PHARM-404 (Lab)	Biopharmaceutics and Pharmacokinetics - I	Major: Core		3+1		
3.	PHARM-405(Theory), PHARM-406 (Lab)	Clinical Pharmacy-I	Major: Core		3+1		
4.	PHARM-407	Pharmaceutical Quality Management System	Major: Core		3		
5.	EW-408	Expository Writing *	General Education		3		
6.	EPS-409	Entrepreneurship *	General Education		2		
Total Credit Hours							20

#	Code	Course Title	Course Type	Prerequisite	Credit hours		
Semester VIII							
1.	PHARM-411 (Theory), PHARM-412 (Lab)	Industrial Pharmacy - II	Major: Core		3+1		
2.	PHARM-413 (Theory), PHARM-414 (Lab)	Biopharmaceutics and Pharmacokinetics - II	Major: Core		3+1		
3.	PHARM-415(Theory), PHARM-416 (Lab)	Clinical Pharmacy-II	Major: Core		3+1		
4.	PHARM-417 (Theory), PHARM-418 (Lab)	Civics & Community Engagement*	General Education	Pharmacy Practice-III	1+1		
5.	PHARM-419 (Theory), PHARM-420 (Lab)	Pharmaceutical Quality Control	Major: Core		2+1		
6.	PHARM-421	Pharmaceutical Management and Marketing**	General Education (Social Sciences)		2		
Total Credit Hours							19
Semester IX							
1.	PHARM-501 (Theory), PHARM-502 (Lab)	Pharmaceutical Technology - I	Major: Core		3+1		
2.	PHARM-503	Pharmaceutical Regulatory Science-I	Major: Core		3		
3.	PHARM-504 (Theory), PHARM-505 (Lab)	Medicinal Chemistry-I	Major: Core		3+1		
4.	PHARM-506 (Theory), PHARM-507 (Lab)	Advanced Clinical Pharmacy-I	Major: Core		3+1		
5.	PHARM-508 (Theory), PHARM-509 (Lab)	Clinical Pharmacology	Major: Core		2+1		
Total Credit Hours							18
Semester X							
1.	PHARM-511 (Theory), PHARM-512 (Lab)	Pharmaceutical Technology - II	Major: Core		3+1		
2.	PHARM-513	Pharmaceutical Regulatory Science-II	Major: Core		3		
3.	PHARM-514 (Theory), PHARM-515 (Lab)	Medicinal Chemistry-II	Major: Core		3+1		
4.	PHARM-516 (Theory), PHARM-517 (Lab)	Advanced Clinical Pharmacy-II	Major: Core		3+1		
5.	PHARM-518	Bioethics (Arts & Humanities Category) **	General Education		2		
6.	PHARM-519	Capstone Project ***	Capstone project		3		
Total Credit Hours							20

*HEC designed model courses may be used by the university. ** The courses recommended by NCRC under the categories of Natural Science, Social Science and Arts & Humanities. *** Capstone project can be supervised by faculty members of any core discipline of Pharmacy*

Research Thesis / Project /Internship

Requirement of field experience/internship

It is a mandatory degree award requirement of three (03) credit hours for the Pharm. D Program. Internships of six (06) to eight (08) weeks (preferably undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field. This requirement cannot be substituted with additional coursework, capstone, or project work.

Mandatory requirement of certifications (non-credited)

Pharm. D students are required to complete three international certifications (non-credited, equivalent to 3 credit hours in total) over the period of a five-year program as a mandatory condition for degree completion. Each certification will be considered equivalent to 1 credit hour if it comprises at least 16 hours. The respective department will guide students in selecting relevant certifications, ensuring alignment with current market needs and the program's objectives.

Requirements of the capstone project

It is a mandatory degree award requirement of three (03) credit hours for the Pharm. D Program. A capstone project is a multifaceted body of work that serves as a culminating academic and intellectual experience for students. The capstone project must be supervised and graded by a faculty member as per the protocols prescribed by the department concerned. This requirement cannot be substituted with additional coursework or an internship.

OPTIONAL SPECIALIZATION CLUSTER SCHEME FOR DOCTOR OF PHARMACY (PHARM-D) PROGRAM – 15 CREDITS (ELECTIVES TO BE CHOSEN FROM ANY CLUSTER)

HEC has encouraged all HEIs to offer students multiple specialization options within the Pharm-D program through well-structured subject clusters that reflect current market trends and industry needs. Each student may choose **one specialization track** from the available clusters. Within each specialization, a pool of elective courses will be offered. After selecting a specialization track, the student must complete **a minimum of 5–6 courses (15 credit hours)** from the respective cluster to qualify for that specialization.

Additional specialization clusters or elective courses in accordance with faculty expertise, institutional capacity, and emerging professional demands can be introduced as advised by HEC. The chosen specialization will appear on the student's transcript or degree—in parentheses—after approval from the university's statutory bodies.

All Pharm-D degrees, with or without specialization, will remain **equivalent for employment** in roles where a Pharm-D qualification is required. However, graduates with specialized training may pursue positions tailored to their specific area of expertise when preferred by employers.

List of Specialization Tracks

- Pharmacology
- Pharmacy Practice
- Pharmaceutics
- Pharmacognosy
- Pharmaceutical Chemistry / Medicinal Chemistry
- Pharmaceutical Analysis / Quality Control
- Industrial Pharmacy
- Hospital and Community Pharmacy
- Regulatory Affairs
- Clinical Research in Pharmacy
- Pharmaceutical Marketing
- Pharmaceutical Management

Award of Degree

The following minimum requirements are prescribed for the award of Doctor of Pharmacy:

a) All courses in the General Education category as prescribed in HEC Undergraduate Education Policy V 1.1, including the courses of "Pakistan Studies and Fehm-e-Quran", must be completed.

b) A minimum of 195 credit hours is required for the award of the Pharm-D degree, in case no specializations are opted by the student.

c) A minimum of 210 credit hours is required for the award of the Pharm-D degree with specialization in a particular domain as mentioned in the document.

d) Capstone/research project of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1.

e) Internship/Field experience of three (03) credit hours must be completed in accordance with HEC Undergraduate Education Policy V 1.1. This requirement cannot be substituted with additional coursework, capstone, research, or project work.

f) CGPA must not be below 2.00/4.00 at the time of completion of the degree program.

NOC from Professional Councils (if applicable)

NA

Faculty Strength		
Degree	**Area/Specialization**	**Total**
PhD	1. Dr. Syed Atif Raza (Pharmaceutics) 2. Dr. Hamid Saeed (Pharmacy) 3. Dr. Nasir Abbas (Pharmaceutics) 4. Dr. Furqan Khursheed Hashmi (Pharmacy Practice) 5. Dr. Amjad Hussain (Pharmaceutics) 6. Dr. Muhammad Zeeshan Danish (Pharmaceutics) 7. Dr. Fatima Rasool (Pharmaceutics) 8. Dr. Muhammad Islam (Pharmaceutical chemistry) 9. Dr. Saiqa Ishtiaq (Pharmacognosy) 10. Dr. Alamgeer (Pharmacology) 11. Dr. Misbah Sultana (Pharmaceutics) 12. Dr. Uzma Saleem (Pharmacology) 13. Dr. Rukhsana Anwar (Pharmacology) 14. Dr. Rahat Shamim (Pharmaceutics) 15. Dr. Muhammad Khalil Ur Rehman (Pharmacognosy) 16. Dr. Imran Tariq (Pharmaceutics) 17. Dr. Ejaz Ali (Pharmaceutical chemistry) 18. Dr. Naureen Shehzadi (Pharmaceutical chemistry) 19. Dr. Abrar Ahmad (Pharmacognosy)	**19**
MPhil	Mr. Muhammad Yar Rizwan (Pharmacology)	**01**
Total		**20**

Present Student Teacher Ratio in the Department					
Total Faculty	**20**	**Total Students**	**719**	**Ratio**	1:35

Course Outlines separately for each course

Punjab University College of Pharmacy
Faculty of Pharmacy
University of the Punjab, Lahore

Course Outline

Programme	Pharm.D 1st Semester	**Course Code**	PHARM-101(Theory), PHARM-102 (Lab)	**Credit Hours**	3+1
Course Title	PHYSICAL PHARMACY -1				

Course Introduction

Physical pharmacy is a foundational pharmaceutical science that applies physical and chemical principles to the development, evaluation, and stability of drug dosage forms. It bridges chemistry, physics, and pharmacy to understand how drug molecules behave, ensuring effective, stable, and bioavailable medication delivery systems. It acts as a bridge between basic sciences and practical pharmacy, focusing on Preformulation, stability, and drug delivery systems to ensure therapeutic effectiveness. Key areas include solubility, rheology, micromeritics, and kinetics.

Key Aspects of Physical Pharmacy:

- Preformulation Studies: Evaluates the physical and chemical properties of a drug substance (e.g., solubility, particle size, polymorphism) before formulating it into a stable dosage form.
- Dosage Form Design: Utilizes principles like surface tension and interfacial phenomena to create stable suspensions, emulsions, and tablets.
- Stability and Kinetics: Predicts the shelf-life of products by understanding drug degradation rates (hydrolysis, oxidation).
- Drug Delivery: Enhances the delivery of drugs to target sites within the body by managing physicochemical characteristics.

Learning Outcomes

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

- Describe the historical evolution of pharmacy through ancient Greek, Arab, and Muslim contributions and the significance of official compendia and texts.
- Explain basic physicochemical principles relevant to drug delivery systems and formulations.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Pharmacy and History:** i. Introduction and orientation to the Pharmacy Profession with the current scope and latest applications.	Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
	ii. A survey of the history of pharmacy through ancient, Greek, and Arab periods with special reference to the contribution of Muslim scientists to pharmacy and allied sciences.	

	iii. The Industrial Revolution and the development of Pharmaceuticals in the 20th century.	
Week 2	iv. The developments in the 21st century, especially with reference to Biotechnology, nanotechnology, and artificial intelligence. **Introduction to Pharmaceutical Literature:** Introduction to the scientific literature, literature types in pharmacy, official texts and compendia, and their significance.	Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science*: Wiley. 3. Allen, L. V. (2021). Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems: Wolters Kluwer Health.
Week 3	**Introductory concepts in Physical Pharmacy** i. Fundamentals and overview of the concepts of physicochemical properties and their application in product development.	Anderson, S. (2005). *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals*: Pharmaceutical Press.
Week 4	Basic concepts of physical pharmacy in dosage forms science and its various applications.	British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
Week 5	**Physicochemical Principles**: i. **Solutions:** Types, concentration expressions, ideal and real solutions, colligative properties, and applications in pharmacy.	Brun, P. L., Crauste-Manciet, S., Krämer, I., Smith, J., & Woerdenbag, H. (2023). *Practical Pharmaceutics: An International Guideline for the Preparation, Care and Use of Medicinal Products*: Springer International Publishing**.** **Assignment:** Make a flow chart of all the physicochemical principles in physical pharmacy
Week 6	**Solubility and Solubilization:** Definition and concepts of solubility and Solubilization, mechanism, factors affecting solubility and solubilization.	**Assignment:** Enlist the basic definitions of physicochemical procedures and give one example each
Week 7	**Dissolution and Permeation:** Definition and concepts**,** types, Factors affecting dissolution and permeation, Noyes-Whitney equation	Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design*: OUP Oxford. 8. *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare**.** **Assignment:** Modeling Dissolution and Permeation of BCS Class II Drugs

Week 8	**Polymorphism:** Basic concept, lattice structure, and significance in pharmaceuticals. Amorphous and crystalline solids and their effect on thermodynamics. Role in dissolution.	**Assignment:** Polymorphism impact on Drug Formulation and Performance.
Week 9	**Ionization and Buffers:** i. Strong vs. Weak Electrolytes, pH, pKa, and buffer systems and capacity.	Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology*: Wiley. 10. Lovett, A. W. (2014). *Introduction to the Pharmacy Profession*: Jones & Bartlett Learning**.** **Assignment:** Make a chart showing acidic and basic buffers list.
Week 10	Henderson Hasselbalch Equation and application in drug formulation.	Ma, J. K. H., & Hadzija, B. (2013). Basic Physical Pharmacy: Jones & Bartlett Learning
Week 11	Hypo, hyper, and Isotonic solutions and pharmaceutical applications.	Sinko, P. J. (2023a). *Martin's Physical Pharmacy and Pharmaceutical Sciences*: Wolters Kluwer Health. 13. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print)*: Taylor & Francis. **Assignment:** Brief note on types of solutions in pharmacy.
Week 12	**Micromeritics:** i. Particle size and its distribution, Texture and morphological characteristics of pharmaceutical powders.	Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*: Elsevier. 15. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
Week 13	Role and importance of micromeritics in pharmacy and medicines.	
Week 14	Methods of particle size analysis, distribution, and morphological determination (sieving, microscopy etc.).	
Week 15	Flow properties: Carr's Index, Hausner's ratio	Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness*: Taylor & Francis.
Week 16	Flow properties: angle of repose.	
Textbooks and Reading Material		
Main source: Adejare, A. (2020). Remington, Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science*: Wiley.		
• **Other sources**: Allen, L. V. (2021). Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems: Wolters Kluwer Health. • Anderson, S. (2005). *Making Medicines: A Brief History of Pharmacy and*		

Pharmaceuticals: Pharmaceutical Press.
- British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
- Brun, P. L., Crauste-Manciet, S., Krämer, I., Smith, J., & Woerdenbag, H. (2023). *Practical Pharmaceutics: An International Guideline for the Preparation, Care and Use of Medicinal Products*: Springer International Publishing.
- Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design*: OUP Oxford.
- *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare.
- Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology*: Wiley.
- Lovett, A. W. (2014). *Introduction to the Pharmacy Profession*: Jones & Bartlett Learning.

Course content (Practical/lab)

1.Introduction to laboratory safety and various apparatus used in laboratory
2.Basic calculation in pharmaceutical analysis
3.Preparation of molar and normal solutions.
4.Determination of specific gravity and density of various solvents by pycnometer.
5.Determinition of solubility of KCl at room temperature.
6.preparation of buffer solutions.
7.preparation of isotonic solution by different methods.
- NaCl equivalent method
- Freezing point depression method
- White Vincent method

8.Standardization of NaOH solution using titration
9.Determination of angle of repose
10.Determination of LBD, TBD, Carr's index and hausner's ratio of given powder samples.
11.Purification of benzoic acid by crystallization.
12.Purification of camphor sample by sublimation

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.

2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
Faculty of Pharmacy
University of the Punjab, Lahore

Course Outline

Programme	Pharm.D 1st Semester	**Course Code**	PHARM-103 (Theory), PHARM-104 (Lab)	**Credit Hours**	3+1
Course Title	PHARMACEUTICAL CHEMISTRY-IA (ORGANIC CHEMISTRY I)				

Course Introduction

Pharmaceutical Chemistry-IA (Organic Chemistry I) course introduces the fundamental principles of organic chemistry with emphasis on concepts that are essential for understanding the chemical basis of drug molecules and pharmaceutical applications. The course covers the basic concepts of chemical bonding, hybridization, resonance, aromaticity, electronic effects, and tautomerism that influence the structure and reactivity of organic compounds. It also provides knowledge of the synthesis, nomenclature, structure, and properties of important functional groups commonly found in pharmaceutical compounds.

Furthermore, the course explores different types of organic reaction mechanisms, including oxidation, reduction, substitution, elimination, and addition reactions, and highlights their relevance in drug synthesis and pharmaceutical transformations. Special attention is given to stereochemistry and conformational analysis, which are crucial for understanding the three-dimensional arrangement of drug molecules and their interaction with biological systems. Overall, the course aims to build a strong foundation in organic chemistry that supports the understanding of medicinal chemistry, pharmacology, and pharmaceutical sciences.

Learning Outcomes

On the completion of the course, the students will:

- **Understand** the fundamental concepts of organic chemistry including chemical bonding, hybridization, resonance, aromaticity, electronic effects, hydrogen bonding, and tautomerism relevant to pharmaceutical compounds.
- **Understand** the structure, nomenclature, properties, and apply knowledge of major functional groups such as alkanes, alkenes, alcohols, phenols, ethers, amines, aldehydes, ketones, carboxylic acids, esters, amides, and aromatic compounds used in drug synthesis.
- **Apply** the principles of organic reaction mechanisms to interpret and predict common reactions such as oxidation, reduction, acylation, esterification, nucleophilic substitution (SN1 and SN2), elimination, and addition reactions.
- **Analyze** the mechanisms of organic reactions occurring in aliphatic and aromatic systems and evaluate their significance in pharmaceutical synthesis and drug development.

- **Differentiate** between various types of stereoisomerism including optical and geometrical isomerism and explain their importance in drug activity and pharmacological response.
- **Interpret** stereochemical representations such as Fischer projections and perspective formulas, and perform conformational analysis of organic molecules with pharmaceutical relevance.

Course Content (Theory)		Assignments/Readings
Week 1	**Unit I: Basic concepts** Introduction to science, chemistry, organic chemistry and pharmaceutical chemistry	Chapter 1. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015.
	Role of pharmaceutical chemistry in pharmacy and medicine	
	Structure of atom and subatomic particles, and chemical bonding	Chapter 1. Review of General Chemistry: Electrons, Bonds, and Molecular Properties. Organic Chemistry. David Klein. John Wiley and Sons, Inc. **Assignment:** Prepare a comparison chart between different types of bonding and hybridization
Week 2	Concept of hybridization	
	Electronegativity	Chapter 3. Electron shift. D. N. Singh. Basic Concepts of Organic Chemistry. Pearson India Education Services Pvt. Ltd. **Assignment:** Make a comparison chart of permanent and temporary electronic effects.
	Inductive effect	
Week 3	Electromeric effect	
	Mesomeric effect	
	Resonance	
Week 4	Steric effect	
	Conjugation	
	Hyperconjugation	
Week 5	Dipole moment	Chapter 21 & 27. Catherine E. Housecroft and Edwin C. Constable. Chemistry. Pearson Education Limited, England. **Assignment:** Write a detail note on significance of hydrogen bonding.
	Hydrogen bonding	
	Tautomerism (keto-enol in tetracyclines and lactam-lactim)	Chapter 4. Fundamentals of organic reactions. Bhupinder Mehta and Manju Mehta. Organic

		Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015.
Week 6	Aromaticity	Chapter 4. Fundamentals of organic reactions. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015. **Assignment:** On an A4 size paper, write criteria of aromaticity and types of aromatic rings.
	Unit II: Synthesis, structure, nomenclature, properties, and pharmaceutical applications of functional organic compounds in drug synthesis: Introduction to functional groups and functionality	Chapter 4. Thomas, G. (2013). Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.
	Role of functional groups in a drug's action and synthesis	
Week 7	Alkanes	Chapter 4-7. Rajesh Agarwal. Organic Chemistry-I (Module IV) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. **Assignment:** Compare hydrocarbons (acyclic and cyclic)
	Alkenes	
	Alkynes	
Week 8	Aromatic compounds (arenes)	
	Alcohols	Chapter 2. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. **Assignment:** Compare alcohols and ethers
	Phenols	
Week 9	Ethers	
	Aldehydes	Chapter 3. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. **Assignment:** Compare aldehydes and ketones
	Ketones	
Week 10	Carboxylic acids	Chapter 4. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw
	Esters	

		Hill Education, India Private Limited. **Assignment:** Write a detail note on carboxylic acid and its derivatives
	Amides	Chapter 12. Thomas M. Lemke. Review of organic functional groups. Lippincott Williams and Wilkins.
Week 11	Amines	Chapter 5. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. **Assignment:** Compare amines and amides
	Alkyl halides	Chapter 1. Rajesh Agarwal. Organic Chemistry-II (Module V) for JEE (Main and Advanced). McGraw Hill Education, India Private Limited. **Assignment:** Compare reactivity of alkanes with alkyl halides
	Unit III. Stereochemistry and conformational analysis Stereoisomerism	Chapter 3. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy students. John Wiley & Sons, Inc. Publication. Chapter 7. Bahl, A., & Bahl, B. A Textbook of Organic Chemistry, 22nd Edition. **Assignment:** Construct a concept map on types of stereoisomers
Week 12	Molecule with more than one chiral center	
	Optical isomerism	
	Dextrorotatory and levorotatory systems	
Week 13	RS system	
	Geometrical isomerism	
	EZ isomers	
Week 14	Resolution of a racemic mixture	
	Conformational analysis	
	Applications in Pharmacy	
Week 15	Unit IV: Types of Reactions and Aromatic systems and their applications Oxidation, reduction	Chapter 5. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy
	Acylation, esterification	

	Nucleophilic substitution reactions	students. John Wiley & Sons, Inc. Publication. **Assignment:** Define a chemical reaction. Classify different types of chemical reactions involved in organic synthesis and explain each type with suitable examples.
Week 16	Elimination reactions	
	Addition reactions	
	Rearrangements and Polymerization reactions	

Textbooks and Reading Material

Main source: Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015.

Other sources: Lemke, T. L., & Williams, D. A. (2013). *Foye's principles of medicinal chemistry* (7th ed.). Lippincott Williams & Wilkins.

Johnson, W. S. (2003). *Organic chemistry in the laboratory*. W. H. Freeman and Company.

Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley.

Brown, W. H., & Bursten, M. L. (2014). *Introduction to organic chemistry* (8th ed.). Wiley.

Vollhardt, K. P. C., & Schore, N. E. (2014). *Organic chemistry: Structure and function* (7th ed.). W. H. Freeman and Company.

Thomas, G. (2013). *Medicinal chemistry: A molecular and biochemical approach*. Oxford University Press.

Carey, F. A. (2007). *Advanced organic chemistry: Part A: Structure and mechanisms* (5th ed.). Wiley.

Prasad, N. D. V. G. S., & Shinde, S. C. (2009). *Pharmaceutical organic chemistry.* Pharma Book Syndicate.

Silverman, R. B. (2014). *The organic chemistry of drug design and drug action* (2nd ed.). Academic Press

Course content (Practical/lab)

1. Good laboratory practice for organic chemistry lab (Protocol for chemical handling of flammable, non-flammable, and acids) and introduction to organic chemistry lab apparatus and instruments.
2. Identify the functional group present in the given organic compound by systematic analysis. (carboxylic acids, phenol, aldehydes, ketones, amines, hydrazine, amide, thioamide, ester, nitro group, alcohol, etc.).
3. To identify compounds by synthesizing their derivatives (such as esters, amides, and salts of COOH; acetate, benzoate of alcohol; benzoate, 2,4-dinitrophenyl ether of phenol, etc.
4. Determination of melting point and boiling points of different organic compounds (Picric acid, oxalic acid, salicylic acid, citric acid, tartaric acid, succinic acid).
5. Purification of various organic compounds by crystallization (e.g., Benzoic acid).
6. Identification of various organic compounds (e.g., Oxalic acid, Salicylic acid, Phthalic acid, Benzoic acid, Cresol, Resorcinol.

Assignments: Types and Number with Calendar				
Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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University of the Punjab, Lahore

Course Outline

Programme	Pharm.D 1st Semester	**Course Code**	PHARM-105 (Theory), PHARM-106 (Lab)	**Credit Hours**	2+1
Course Title	BIOCHEMISTRY-I				

Course Introduction

The course includes an introduction to biochemistry, focusing on the importance of biochemical reactions in maintaining life. It also covers carbohydrates, their structure, classification, functions, and metabolism, explaining how they serve as major energy sources. In addition, students study lipids, including their structure, types, and biological roles in energy storage and cell membranes. The course further discusses vitamins, including both water-soluble vitamins (B-complex and vitamin C) and fat-soluble vitamins (A, D, E, and K), highlighting their biochemical functions, dietary sources, and deficiency effects. Overall, this course provides basic knowledge of essential biomolecules and metabolic processes that form the foundation for further studies in biochemistry and related life sciences.

Learning Outcomes

On the completion of the course, the students will:

1. Analyze the scope and importance of pharmaceutical biochemistry and explain its role in drug action, disease mechanisms, and clinical decision-making in pharmacy practice.
2. Classify and interpret the structure, isomerism, and properties of carbohydrates, and analyze major carbohydrate metabolic pathways (glycolysis, PPP, TCA cycle, etc.), evaluating their dysregulation in metabolic disorders.
3. Explain and analyze bioenergetic principles, including ATP generation, electron transport chain, and oxidative phosphorylation, and evaluate the biochemical impact of mitochondrial dysfunction and reactive oxygen species in health and pharmaceutical contexts.
4. Classify and analyze lipids, their digestion, metabolism, and biosynthesis, and evaluate the relationship between lipid metabolic disorders and their pharmaceutical significance.
5. Classify and explain vitamins based on structure and function, and analyze their roles in metabolism, deficiencies, toxicities, and drug–vitamin interactions in clinical and pharmaceutical practice.
6. Classify and explain hormones and their biochemical roles, and analyze their clinical and pharmaceutical applications in disease diagnosis and therapy.

Course Content (Theory)		Assignments/Readings
Week 1	**Unit I: Basic concepts** Introduction to Biochemistry	Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). Stryer's biochemistry (8th ed.). W. H. Freeman and Company. Tortora, G. J., & Derrickson, B. H. (2020). Principles of anatomy and physiology (15th ed.). Wiley Lippincott Williams & Wilkins. (2020). Lippincott's illustrated reviews: Biochemistry. Lippincott Williams & Wilkins.
	Types of biochemical reactions	
	Chemical reactions pharmaceutical importance	
Week 2	Concept of anabolism and catabolism	
	Role of pharmaceutical chemistry in pharmacy and medicine	
	Role of biochemistry in pharmacy and medicine	
Week 3	Carbohydrates introduction	
	Classification of carbohydrates	
	Physical properties and chemical reactions of carbohydrates	
Week 4	Biological importance of carbohydrates	
	Pharmaceutical importance of carbohydrates	
	Pharmaceutical importance of carbohydrates	
Week 5	Metabolism of Carbohydrates	
	Types of metabolic pathways	
	Metabolic pathways of carbohydrates	
Week 6	Metabolic pathway of carbohydrates	
	Metabolic pathway of carbohydrates	Lippincott Williams & Wilkins. (2020). Lippincott's illustrated reviews: Biochemistry. Lippincott Williams & Wilkins.
	Metabolic pathway of carbohydrates	
Week 7	Lipids introduction	
	Classification of lipids	
	Physical properties and chemical reactions of lipids	
Week 8	Biological importance of lipids	
	Pharmaceutical importance of lipids	
	Pharmaceutical importance of lipids	
Week 9	Metabolism of lipids	
	Types of metabolic pathways	
	Metabolic pathways of lipids	
Week 10	Metabolic pathways of lipids	
	Metabolic pathways of lipids	
	Metabolic pathways of lipids	
Week 11	Introduction to Vitamins	

	Classification of vitamins	
	Chemical classification of vitamins	Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley. Devlin, T. M. (2016). Textbook of biochemistry with clinical correlations (8th ed.). Wiley-Liss.
Week 12	Water soluble vitamins introduction	
	Vitamin A	
	Vitamin D	
Week 13	Vitamin E	
	Vitamin K	
	Vitamins Comparison	
Week 14	Fat soluble vitamins introduction	
	B-complex vitamins	
	Non-B complex vitamins	
Week 15	Bioenergetics introduction	Lippincott Williams & Wilkins. (2020). Lippincott's illustrated reviews: Biochemistry. Lippincott Williams & Wilkins.
	Energy production	
	Energy calculation	
Week 16	Electron transport chain	
	Energy calculation of metabolic pathways	
	Energy calculation of metabolic pathways	

Textbooks and Reading Material

Main source: Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). Stryer's biochemistry (8th ed.). W. H. Freeman and Company.

Other sources: Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.

Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of biochemistry (7th ed.). W. H. Freeman and Company.

Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley.

Devlin, T. M. (2016). Textbook of biochemistry with clinical correlations (8th ed.). Wiley-Liss.

Gout, A. M. (2019). Biochemistry for the pharmaceutical sciences (4th ed.). Wiley.

Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company

Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley.

Tortora, G. J., & Derrickson, B. H. (2020). Principles of anatomy and physiology (15th ed.). Wiley

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). Molecular biology of the cell (6th ed.). Garland Science.

Lippincott Williams & Wilkins. (2020). Lippincott's illustrated reviews: Biochemistry. Lippincott Williams & Wilkins.

Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., & Weil, P. A. (2017). Harper's illustrated biochemistry (31st ed.). McGraw-Hill Education.

Course content (Practical/lab)		
1	Good laboratory practice for the biochemistry lab (Protocol for Chemical Handling of flammable, non-flammable, and acids)	
2	Introduction to biochemistry lab apparatus and instruments.	
3	**QUALITATIVE TESTS FOR IDENTIFICATION OF BIOMOLECULES CARBOHYDRATES**	
	1	Starch
	2	Dextrin
	3	Glucose
	4	Fructose
	5	Lactose
	6	Maltose
4	**QUALITATIVE TESTS FOR IDENTIFICATION OF BIOMOLECULES PROTEINS**	
	7	Proteins
	8	Tryptophan
	9	Arginine
	10	Cysteine
	11	Albumin
	12	Gelatin

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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University of the Punjab, Lahore

Course Outline

Programme	Pharm.D 1st Semester	**Course Code**	PHARM-107 (Theory), PHARM-108 (Lab)	**Credit Hours**	3+1
Course Title	Physiology-I				

Course Introduction

Physiology is the study of the normal functions and processes of the human body. This course provides students with a basic understanding of how the body is organized, how body systems communicate and work together, and how internal balance is maintained during everyday activities. It covers fundamental concepts of cellular function, movement, coordination, control mechanisms, energy production, circulation, and digestion. Students will develop knowledge of the processes that support growth, health, and survival, while understanding how different systems respond to changing conditions. This course serves as an essential foundation for further studies in medicine. Practical applications of physiology will help students relate theoretical concepts to real-life health conditions, body responses, and clinical situations. Students may also study basic experiments, measurements, and physiological processes in laboratory settings.

Learning Outcomes

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

1. Explain the structure and function of cell components, how molecules move across membranes, and key processes like fluid balance, the cell cycle, and apoptosis in maintaining cellular stability.
2. Describe how the nervous system controls body functions, including how neurons work, how action potentials and synapses function, the role of neurotransmitters and sensory receptors, and the structure and function of the central and autonomic nervous systems.
3. Explain the structure and types of skeletal muscles, how they contract, and the role of the neuromuscular junction in muscle activity.
4. Describe the structure and function of the heart, including the cardiac cycle, blood flow, heart sounds, and electrical conduction, and interpret ECG patterns and their clinical relevance.
5. Outline the process of digestion and absorption, including digestive secretions, how they are regulated, and the steps from eating to defecation.

Course Content (Theory)		**Assignments/Readings**
Week 1	Basic Cell Functions Overview of the physical structure of the cell	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The

	Extracellular fluid, intracellular fluid, phagocytosis	mechanisms of body function (16th ed.). McGraw-Hill Education. **Assignment:** Learn the covered topics in detail
Week 2	Pinocytosis, cell cycle	
	Apoptosis	
	Movement of molecules across cell membranes	
Week 3	Diffusion, active transport, co-transport, counter-transport	
	Basic principles of osmosis, osmotic pressure	
	Osmotic equilibrium, endocytosis and exocytosis	
Week 4	Central Nervous System	Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers **Assignment:** Prepare a concept chart on CNS in detail
	Physiological anatomy of brain and spinal cord, CSF	
	Blood brain barrier, types of sleep	
Week 5	Muscle Physiology Physiological anatomy of skeletal muscle	**Assignment:** give presentation on muscles and its contraction process
	Types of skeletal muscle fibers, general and molecular mechanisms of muscle contraction,	
	Physiological anatomy of neuromuscular junction	
Week 6	Neural Control Mechanisms	Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers
	Functional classes of neurons,	
	Voltage-gated sodium and potassium channels	
Week 7	Resting membrane potential,	Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier.
	Initiation and propagation of action potential	
	Refractory period, all or nothing principle,	
Week 8	Synapses, types of synapses,	
	Physiological anatomy of synapses	
	Excitatory and inhibitory receptors in the postsynaptic membrane	
Week 9	Excitatory and inhibitory postsynaptic potentials,	
	Classification of sensory receptors	
	Neurotransmitters and neuromodulators	**Assignment:** Attempt quiz from covered topic of this chapter
Week 10	Autonomic Nervous System	

	Physiological anatomy of sympathetic and parasympathetic nervous system	Firdaus, M. (2021). Firdaus review of physiology: Included BCQs and viva (21st ed.). Riaz Medical Publishers
	Pre-ganglionic and post-ganglionic neurons	
	Synthesis and secretion of acetylcholine	
Week 11	Synthesis and secretion of nor-epinephrine from nerve terminal	
	Effects of sympathetic and parasympathetic nervous system on various organs of the body,	
	Denervation supersensitivity and its mechanism, autonomic reflexes	**Assignment:** Prepare flow chart of ANS.
Week 12	Physiological anatomy of heart muscle	Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier.
	Structure of heart	
	Course of blood flow through heart	
Week 13	The cardiac cycle,	**Assignment:** Attempt quiz on covered topics of Heart
	Conduction system of heart,	
	Characteristics of normal electrocardiogram, relationship of electrocardiogram to the cardiac cycle, clinical significance of abnormal electrocardiographic patterns	
Week 14	Definitions: (systole, diastole, stroke volume, cardiac output, preload, afterload, ejection fraction). heart sounds, murmurs	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education.
	Gastro-intestinal secretions (salivary secretions, gastric secretions)	
	Gastro-intestinal secretions (pancreatic secretions, biliary secretions	
Week 15	Nervous and hormonal regulation of gastric secretions	Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier.
	Nervous and hormonal regulation of gastric secretions	
	Mastication, deglutition, gastric emptying	**Assignment:** prepare presentation on GIT and its Regulation
Week 16	Intestinal movements (peristalsis, segmenting & mixing),	
	Biliary enterohepatic circulation, defecation,	
	Overview of enteric nervous system.	
Textbooks and Reading Material		
Main source: Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education**.**		
Other sources: 1. Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X. J. (2019). Ganong's review of medical physiology (26th ed.). McGraw-Hill Education. 2.Costanzo, L. S. (2024). BRS physiology (7th ed.). Wolters Kluwer		

3. Firdaus, M. (2021). Firdaus review of physiology: Included BCQs and viva (21st ed.). Riaz Medical Publishers.
4. Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier.
5. Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers
6. Sherwood, L. (2016). Human physiology: From cells to systems (9th ed.). Cengage Learning.
7. Wecker, L., & Ingram, S. L. (2024). Brody's human pharmacology: Mechanism-based therapeutics (7th ed.). Elsevier.
8. Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education.

Course content (Practical/lab)

At the end of this course the student will be able to:

1. Determine the systolic and diastolic blood pressure of a human volunteer using a mercury sphygmomanometer and the heart rate by the palpatory method
2. Determine the blood pressure and heart rate of a human volunteer during physical activity (exercise)
3. Demonstrate the technique of venous blood sampling from human volunteer or using simulators/training model.
4. Demonstrate the administration technique of intramuscular injection to human volunteer or using simulators/training model.
5. Demonstrate the administration technique of subcutaneous injection to human volunteer or using simulators/training model.
6. Demonstrate the administration technique of intra-venous injection to human volunteer or using simulators/training model.
7. Determine the body mass index (BMI) of a human volunteer
8. Observe the peristaltic activity (spontaneous contractions) of rabbit jejunum
9. Determine the visual acuity, far vision, near vision and field of vision (Perimetry).
10. Explain the various abnormal electrocardiogram patterns and discuss the clinical significance
11. Observe the effects of different concentrations of salt solutions on red blood cells (isotonic, hypotonic, and hypertonic).

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

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Course Outline

Programme	Pharm.D 1st Semester	**Course Code**	Functional English I (ENG-109)	**Credit Hours**	3+1
Course Title	Functional English				

Course Introduction

This course is designed to equip first-year undergraduate students with a strong foundation in the English language for academic and professional purposes. It focuses on reactivating and strengthening core grammatical structures while integrating these into the four key language skills: reading, writing, listening, and speaking.

The course emphasizes practical application, enabling students to communicate accurately, clearly, and confidently in various contexts.

Learning Outcomes

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

- Apply enhanced English communication skills through effective use of word choices, grammar, and sentence structure.
- Produce clear and understandable English pronunciation and construct simple, compound, complex, and compound-complex sentences correctly.
- Interpret tones, biases, stereotypes, assumptions, and inferences in communication.
- Demonstrate active listening by overcoming listening barriers and practicing focused listening.
- Apply principles of inclusive communication effectively.
- Structure written documents effectively.
- Produce professional writing including business emails, memos, reports, and formal letters.
- Develop competence in informal communication including small talk, networking, and conversational skills.
- Organize presentation content logically, design effective visual aids, and engage audiences.
- Manage stage fright, modulate voice, and use appropriate body language in public speaking.

Course Content		**Assignments/Readings**
Week 1	Foundations of Functional English: Word formation (affixation, compounding, clipping,	**Assignment:** Practice the concepts given in the class.

	back formation, etc.), Sound production and pronunciation.	
	Vocabulary building (contextual usage, synonyms, antonyms and idiomatic expressions) modifiers, articles and word classes.	
	Practice the word formation and article, modifier.	
Week 2	Communicative grammar (subject-verb-agreement, verb tenses, fragments, run-ons)	Practice the concepts given in the class.
	Sentence structure (simple, compound, complex and compound-complex)	
	Practice of sentence structure.	
Week 3	Understanding purpose and audience.	Revision of the topic.
	Understanding purpose, audience and Context.	
	Contextual interpretation (tones, biases and stereotypes)	
Week 4	Contextual interpretation: assumptions and inferences.	Revision of the topic.
	Revision of contextual interpretation.	
	Discussion on the assignment topic	
Week 5	Active listening	Revision of the topic.
	Active listening (Focused Listening.)	
	Discussion of assignment errors.	
Week 6	Active listening (components of listening).	Revision of the topic.
	Active listening (Quiz)	
	Active listening (overcoming listening barriers.)	
Week 7	Active listening: Role of interpretation in listening.	Revision of the topic.
	Create relevance with previous topics: understanding audience, purpose and context.	
	Relevance with Contextual interpretation.	
Week 8	Reading strategies (what is it and its importance)	Revision of the topic.
	Reading strategies (skimming, scanning)	
	Reading strategies (SQ4R, critical reading)	
Week 9	Reading strategies (practice of these with the help of text.)	Revision of the topic.
	Communication: introduction and values of it.	

	Communication: (clarity, coherence and conciseness)	Revision of the topic.
Week 10	Communication: (other 4 Cs)	Revision of the topic.
	Communication: (oral test base discussion over 7Cs)	Revision of the topic.
	Inclusivity in communication: its requirement and role)	Revision of the topic.
Week 11	Inclusivity in communication: (gender-neutral language, stereotypes, cross-cultural communication)	Revision of the topic.
	Communication: relevance of both topics done before.	Revision of the topic.
	Professional writing: (business e-mails)	Practice of the Writing.
Week 12	Professional writing: (business e-mails) Practice Day. + Assignment Topic given	Practice of the Writing.
	Structuring documents (introduction and body)	Revision of the topic
	Structuring documents: (conclusion and its types)	
Week 13	Structuring documents: (formatting + Assignment Discusion)	
	Professional writing: (Formal E-mails)	
	Professional writing: (Formal E-mails) Practice Day.	
Week 14	Informal communication (what is it, need and comparison with formal talks.)	
	Informal communication (small talk, networking and conversational skills)	
	Presentation skills (organization content, visual aids)	
Week 15	Presentation skills: (role of audience and stage fright, voice modulation and body language.)	
	Presentation skills: Presentation Day	
	Presentation skills: Presentation Day	
Week 16	Professional writing: Memo	
	Professional writing: Reports	
	Professional writing Practice Day.	

Textbooks and Reading Material

1. “Understanding and Using English Grammar” by Betty Schrampfer Azar.
2. “English Grammar in Use” by Raymond Murphy.
3. “The Blue Book of Grammar and Punctuation” by Jane Straus.
4. “English for Specific Purposes: A Learning-Centered Approach” by Tom Hutchinson and Alan Waters.
5. “Cambridge English for Job-hunting” by Colm Downes.

6. “Practical English Usage” by Michael Swan.
7. “Reading Literature and Writing Argument” by Missy James and Alan P. Merickel.
8. “Improving Reading: Strategies, Resources, and Common Core Connections” by Jerry Johns and Susan Lenski.
9. “Comprehension: A Paradigm for Cognition” by Walter Kintsch.
10. “Communication Skills for Business Professionals” by J.P. Verma and Meenakshi Raman

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 4	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 6
Assignment 2 (Post-mid)	Week 12		Quiz 2 (post-mid)	Week 15

Assessment

Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	PHARM-111(Theory), PHARM-112 (Lab)	**Credit Hours**	3+1
Course Title	PHYSICAL PHARMACY-II				

Course Introduction

Physical pharmacy is a foundational pharmaceutical science that applies physical and chemical principles to the development, evaluation, and stability of drug dosage forms. It bridges chemistry, physics, and pharmacy to understand how drug molecules behave, ensuring effective, stable, and bioavailable medication delivery systems. It acts as a bridge between basic sciences and practical pharmacy, focusing on preformulation, stability, and drug delivery systems to ensure therapeutic effectiveness. Key areas include solubility, rheology, micromeritics, and kinetics.

Key Aspects of Physical Pharmacy:

- Preformulation Studies: Evaluates the physical and chemical properties of a drug substance (e.g., solubility, particle size, polymorphism) before formulating it into a stable dosage form.
- Dosage Form Design: Utilizes principles like surface tension and interfacial phenomena to create stable suspensions, emulsions, and tablets.
- Stability and Kinetics: Predicts the shelf-life of products by understanding drug degradation rates (hydrolysis, oxidation).
- Drug Delivery: Enhances the delivery of drugs to target sites within the body by managing physicochemical characteristics.

Learning Outcomes

On the completion of the course, the students will be able to explain basic physicochemical principles relevant to drug delivery systems and formulations.

Course Content (Theory)		**Assignments/Readings**
Week 1	**Surface and Interfacial Phenomena:** i. Surface and interfacial tension. ii. Types of surfactants, techniques to reduce surface tension, and pharmaceutical applications.	Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.

Week 2	Micellization and its application in dosage forms.	Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science*: Wiley. Allen, L. V. (2021). Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems: Wolters Kluwer Health.
Week 3	**Adsorption:** Mechanisms, types of adsorption, adsorption isotherms.	Anderson, S. (2005). *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals*: Pharmaceutical Press.
Week 4	**Disperse Systems:** i. **Colloids:** Introduction, types, methods of preparation, optical/kinetic/electrical properties, stability and pharmaceutical applications.	British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
Week 5	**Emulsions:** Types, theories of emulsification, emulsifying agents (classification and properties), stability issues, pharmaceutical applications. iii. **Suspensions:** Types, methods of preparation, properties, types of suspending agents, stability concerns, pharmaceutical applications.	Brun, P. L., Crauste-Manciet, S., Krämer, I., Smith, J., & Woerdenbag, H. (2023). *Practical Pharmaceutics: An International Guideline for the Preparation, Care and Use of Medicinal Products*: Springer International Publishing**.** **Assignment:** Differentiate between emulsions and suspensions and make a table on the chart paper.
Week 6	**Rheology:** i. Fluid flow behaviors, Rheograms	**Assignment:** Different terminologies regarding rheology with examples
Week 7	1.Newtonian and non-Newtonian liquids. 2. Thixotropy, anti-thixotropy, and rheopexy.	Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design*: OUP Oxford. 8. *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare**.** **Assignment:**
Week 8	Factors affecting and significance in pharmaceutical formulations.	

		Enlist materials on daily basis usage showing non Newtonian behavior.
Week 9	**Stability Studies in Pharmacy:** i. Introduction, factors affecting stability, types of stability studies.	Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology*: Wiley. 10. Lovett, A. W. (2014). *Introduction to the Pharmacy Profession*: Jones & Bartlett Learning**.** **Assignment:** Types of stability studies and also rate and order of reactions.
Week 10	ii. Rate of reactions and order of kinetics	Ma, J. K. H., & Hadzija, B. (2013). Basic Physical Pharmacy: Jones & Bartlett Learning
Week 11	Drug degradation: Phase separation, hydrolysis, oxidation, photolysis and other pathways of drug degradation. Role of pH, temperature and ionic strength.	Sinko, P. J. (2023a). *Martin's Physical Pharmacy and Pharmaceutical Sciences*: Wolters Kluwer Health. 13. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print)*: Taylor & Francis. **Assignment:** Effect of degradation on different formulations.
Week 12	**Unit Operations in Pharmacy:** i. Introduction to terminologies and concepts of Precipitation, crystallization	Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*: Elsevier. 15. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
Week 13	evaporation, distillation, efflorescence, deliquescence, lyophilization, elutriation, desiccation, ignition,	
Week 14	fusion, sublimation, calcination, decantation, adsorption,	
Week 15	centrifugation, trituration, levigation, and dialysis.	Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness*: Taylor & Francis.
Week 16	Revision of all the syllabus, and presentations of the topics.	

Textbooks and Reading Material

Main source: Adejare, A. (2020). Remington, Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science*: Wiley.

Other sources: Allen, L. V. (2021). Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems: Wolters Kluwer Health.

- Anderson, S. (2005). *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals*: Pharmaceutical Press.
- British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
- Brun, P. L., Crauste-Manciet, S., Krämer, I., Smith, J., & Woerdenbag, H. (2023). *Practical Pharmaceutics: An International Guideline for the Preparation, Care and Use of Medicinal Products*: Springer International Publishing.
- Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design*: OUP Oxford.
- *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare.
- Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology*: Wiley.
- 10. Lovett, A. W. (2014). *Introduction to the Pharmacy Profession*: Jones & Bartlett Learning.

Course content (Practical/lab)

1.Preparation of castor oil emulsion
2.Preparation of liquid paraffin emulsion
3.Preparation of distilled water by distillation assembly.
4.Determination of viscosity of liquids by Ostwald viscometer.
5.Measurement of surface tension of liquids by stalagmometer.
6.Separation of three compounds by shake flask extraction.
7.Determination of log P values for acidic and basic compounds.
8.Preparation of silver chloride precipitates.
9.Kinetics of Acetylsalicylic acid hydrolysis.
10. Estimation of Critical micelle concentration of a surfactant in water.

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

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Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	PHARM-113 (Theory), PHARM-114 (Lab)	**Credit Hours**	3+1
Course Title	PHARMACEUTICAL CHEMISTRY-IB (ORGANIC CHEMISTRY-II)				

Course Introduction

Pharmaceutical Chemistry IB (Organic Chemistry–II) is a core subject that builds upon the fundamental principles of organic chemistry and extends them toward their application in the design, synthesis, and understanding of pharmaceutical compounds. This course focuses on the structural, mechanistic, and functional aspects of organic molecules that play a vital role in drug discovery and development.

The subject emphasizes important classes of organic compounds such as heterocyclic compounds, aromatic systems, and biologically relevant molecules, which form the backbone of many therapeutic agents. Students gain insight into reaction mechanisms, structure–activity relationships (SAR), and the physicochemical properties that influence drug behavior, including solubility, stability, and bioavailability. In addition, the course introduces modern concepts of organic synthesis such as green chemistry, microwave-assisted synthesis, and the use of biocatalysts, highlighting environmentally sustainable and efficient approaches to drug synthesis. Understanding these concepts enables students to appreciate how chemical modifications can optimize drug efficacy and minimize adverse effects.

Overall, this course serves as a bridge between theoretical organic chemistry and its practical application in pharmacy. It equips students with the knowledge required to understand how drugs are designed, synthesized, and evaluated, forming a strong foundation for advanced studies in medicinal chemistry and pharmaceutical sciences.

Learning Outcomes

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

1. **Define and recall** fundamental concepts of organic synthesis, including total synthesis, semi-synthesis, biocatalysis, green chemistry, and microwave-assisted synthesis.
2. **Describe** the preparation, properties, and pharmaceutical relevance of key heterocyclic compounds and fused ring systems.
3. **Explain** the principles, mechanisms, and significance of various synthetic approaches used in the preparation of pharmaceutical compounds.

4. **Analyze and differentiate** between conventional and modern synthetic techniques in terms of efficiency, cost, environmental impact, and practical feasibility.
5. **Evaluate** the advantages and limitations of green chemistry and biocatalytic approaches compared to traditional chemical synthesis methods.
6. **Design** simple synthetic pathways or propose suitable strategies incorporating efficient and environmentally sustainable methods for the synthesis of organic compounds.
7. **Apply** advanced organic synthesis methods, including green chemistry and microwave-assisted synthesis, in pharmaceutical compound development.
8. **Demonstrate** laboratory proficiency in synthesizing pharmaceutically important compounds using classical and green organic methods.

Course Content (Theory)		**Assignments/Readings**
Week 1	Introduction to organic reactions, Substitution, addition, elimination, rearrangement Oxidation, reduction, condensation, hydrolysis and polymerization Baeyer-Villiger oxidation	Chapter 5. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy students. John Wiley & Sons, Inc. Publication. **Assignment:** Define a chemical reaction. Classify different types of chemical reactions involved in organic synthesis and explain each type with suitable examples.
Week 2	Arndt-Eistert reaction Diels-Alder reaction Grignard's reaction	Peter Sykes. A guide to mechanisms in organic chemistry. Longman group Ltd. **Assignment:** Practice the covered reactions with different examples
Week 3	Metal Hydride reduction Wolff-Kishner reduction Friedel-Crafts reaction	Peter Sykes. A guide to mechanisms in organic chemistry. Longman group Ltd. **Assignment:** Practice the covered reactions with different examples
Week 4	Perkin reaction Cannizzaro's reaction Mannich reaction	Peter Sykes. A guide to mechanisms in organic chemistry. Longman group Ltd. **Assignment:** Prepare a concept map on a chart paper summing up all reactions discussed in classes. Title of the project is "A visual guide to organic reactions"
Week 5	Heterocyclic compounds and their classification	Chapter 2. Louis D. Quin and John A. Tyrell. Fundamentals of

	Hantzsch Widman (HW) Nomenclature of heterocyclic compounds	heterocyclic chemistry, John Wiley & Sons, Inc. Publication **Assignment:** Attempt review exercise at the end of Chapter 2
	Replacement nomenclature of heterocyclic compounds	
Week 6	Preparation and properties of pyrrole	Chapter 26. Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015. **Assignment:** Make a concept map of the chemical reactions given by 5-membered heterocycles
	Preparation and properties of furan	
	Preparation and properties of thiophene	
Week 7	Preparation and properties of pyridine	Chapter 11. Paul M. Dewick. Essentials of Organic Chemistry. John Wiley & Sons, Inc. Publication. **Assignment:** Compare in the form of a table the chemical synthesis, physicochemical properties and applications of 6-membered heterocycles
	Preparation and properties of pyrimidine	
	Preparation and properties of pyrazine	
Week 8	Preparation and properties of indole	Chapter 6. Lutfun Nahar and Satyajit Sarker. Chemistry for Pharmacy students. John Wiley & Sons, Inc. Publication. **Assignment:** Attempt exercise at the end of Chapter 26
	Preparation and properties of quinoline	
	Preparation and properties of Isoquinoline	
Week 9	Heterocycles in pharmaceuticals: imidazole (histamine, antifungals)	Wilson and Gisvold's Text book of organic, medicinal and pharmaceutical chemistry. Lippincott Williams and Wilkins. **Assignment:** Make a poster entitled "Heterocycles in nature and pharmaceuticals"
	Purine/pyrimidine bases (DNA/RNA), benzoxazole and benzothiazole	
	Introduction to reactive intermediates	Chapter 1. Maya Shankar Singh. Reactive Intermediates in Organic Chemistry. Wiley-VCH Verlag GmbH & Co., Germany.
Week 10	Carbocations as reaction intermediates	Chapter 2-5. Maya Shankar Singh. Reactive Intermediates in Organic Chemistry. Wiley-VCH Verlag GmbH & Co., Germany.
	Carbanions as reaction intermediates	
	Carbenes as reaction intermediates	

		Assignment: Attempt quiz from the covered lesson
Week 11	Nitrenes as reaction intermediates Benzynes as reaction intermediates	Chapter 6-7. Maya Shankar Singh. Reactive Intermediates in Organic Chemistry. Wiley-VCH Verlag GmbH & Co., Germany. **Assignment:** Attempt quiz from the covered lesson
	Free Radicals as reaction intermediates	Chapter 4. Maya Shankar Singh. Reactive Intermediates in Organic Chemistry. Wiley-VCH Verlag GmbH & Co., Germany. **Assignment:** Prepare a comparison chart for the reactive intermediates.
Week 12	Free radical scavengers and their applications	Chapter 4. Barry Halliwell and John M. C. Free radicals in biology and medicine. Gutteridge. Oxford University Press.
	Pinacol-Pinacolone rearrangement Wagner Meerwein rearrangement	Chapter 2. S. N. Sanyal. Reactions, rearrangements and reagents. Bharati Bhawan Publishers and Distributors. **Assignment:** Attempt quiz from the reactions covered
Week 13	Wolff rearrangement Hofmann rearrangement Beckmann rearrangement	Chapter 2. S. N. Sanyal. Reactions, rearrangements and reagents. Bharati Bhawan Publishers and Distributors. **Assignment:** Attempt quiz from the reactions covered
Week 14	Aldol condensation Favorskii rearrangement Wittig rearrangement	Chapter 2. S. N. Sanyal. Reactions, rearrangements and reagents. Bharati Bhawan Publishers and Distributors. **Assignment:** Attempt quiz and prepare a poster on a chart paper summing up all rearrangement reactions discussed in classes. Title of the project is "The World of Rearrangement Reactions"

<table>
<tr><td rowspan="2">Week 15</td><td>Chemical synthesis and its environmental impact</td><td rowspan="2">Unit 1. Organic synthesis. Sathyabama Institute of Science and Technology. www.sathyabama.ac.in
Chapter 10. Thomas, G. (2013). Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.</td></tr>
<tr><td>Total Synthesis, Semi-synthesis and Retrosynthesis</td></tr>
<tr><td></td><td>Biocatalysis, Enzymes as biocatalysts</td><td rowspan="4">Stefanache, A., Marcinschi, A., Marin, G. A., Mitran, A. M., Lungu, I. I., Miftode, A. M., ... & Hancianu, M. (2025). Green chemistry approaches in pharmaceutical synthesis: sustainable methods for drug development. Appliedchem, 5(2), 13.
Assignment: Prepare a poster on conventional vs green chemical synthesis</td></tr>
<tr><td rowspan="3">Week 16</td><td>Green synthesis and principles</td></tr>
<tr><td>Methods of green synthesis</td></tr>
<tr><td>Microwave-Assisted Synthesis</td></tr>
<tr><td colspan="3">Textbooks and Reading Material</td></tr>
<tr><td colspan="3">Main source: Bhupinder Mehta and Manju Mehta. Organic Chemistry. 2nd Ed. PHI Learning Private Ltd. 2015.</td></tr>
<tr><td colspan="3">Other sources: Lemke, T. L., & Williams, D. A. (2013). Foye's principles of medicinal chemistry (7th ed.). Lippincott Williams & Wilkins.
• Johnson, W. S. (2003). Organic chemistry in the laboratory. W. H. Freeman and Company.
• Abraham, D. J. (2017). Burger's medicinal chemistry and drug discovery (8th ed.). Wiley.
• Brown, W. H., & Bursten, M. L. (2014). Introduction to organic chemistry (8th ed.). Wiley.
• Vollhardt, K. P. C., & Schore, N. E. (2014). Organic chemistry: Structure and function (7th ed.). W. H. Freeman and Company.
• Thomas, G. (2013). Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.
• Carey, F. A. (2007). Advanced organic chemistry: Part A: Structure and mechanisms (5th ed.). Wiley.
• Prasad, N. D. V. G. S., & Shinde, S. C. (2009). Pharmaceutical organic chemistry. Pharma Book Syndicate.
• Silverman, R. B. (2014). The organic chemistry of drug design and drug action (2nd ed.). Academic Press</td></tr>
</table>

Course content (Practical/lab)

1. Synthesis of iodoform
2. Synthesis of Methyl salicylate by condensation reaction.
3. Synthesize paracetamol (acetaminophen) through nucleophilic and elimination reactions.
4. Synthesis of Aspirin (Acetylsalicylic Acid) via SN Nucleophilic Acyl Substitution.
5. Synthesis of Acetanilide via nucleophilic Acyl Substitution reaction.
6. Synthesis of Dibenzalacetone using crossed aldol (or mixed-aldol) reaction, which is used extensively in organic synthesis to form C-C bonds.
7. Synthesis of Butyl Acetate (Fruit Fragrance) via Nucleophilic Acyl Substitution
8. Synthesis of 2,4,6-Tribromophenol via electrophilic aromatic Substitution
9. Synthesis of Acetone from Isopropyl Alcohol via Elimination (E1) reaction.
10. Synthesize salicylic acid from phenol using the Riemer-Tiemann reaction, involving the formation of the phenoxide ion, carboxylation, and hydrolysis.
11. Synthesize Nifedipine using the classical Hantzsch method, involving condensation and reduction reactions.
12. Development of Green Methodology for Surfactant-Assisted Williamson Synthesis of 4-Benzyloxy Benzoic Acid (Ether) in Aqueous Media.
13. Synthesis of Sulfathiazole using a safer and convenient sulfonylation method.
14. Synthesize salicylic acid from phenol using Kolbe's electrolysis, a simple and recent method in organic compound synthesis, especially for drugs.
15. Synthesis of 1-Bromo-3-Chloropropane via SN2 Nucleophilic Substitution

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.

3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

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Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	PHARM-115 (Theory), PHARM-116 (Lab)	**Credit Hours**	2+1
Course Title	PHARMACEUTICAL CHEMISTRY- IIB (BIOCHEMISTRY-II)				

Course Introduction

This course introduces the fundamental concepts of biochemistry with emphasis on clinical and pharmaceutical applications. It covers proteins and amino acids, including their structure, classification, metabolism, and related disorders such as urea cycle and heme abnormalities. The course also explores nucleic acids and their role in modern therapies like gene delivery and diagnostics.

Students will study enzymes, their classification, mechanisms, and regulation, along with the role of coenzymes and drug–enzyme interactions. Key signaling molecules such as cAMP and calcium ions are discussed in the context of metabolic regulation.

An introduction to clinical biochemistry is included, focusing on the importance of laboratory tests such as uric acid, cholesterol, bilirubin, and creatinine in disease diagnosis. Overall, the course links biochemical principles with real-world medical and pharmaceutical applications.

Learning Outcomes

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

1. **Define and recall** proteins, amino acids, enzymes, nucleic acids, and secondary messengers. Recall their classifications, essential amino acids, peptide bonds, and basic lab tests.
2. **Describe** protein structure, amino acid properties, metabolism, enzyme classes, nucleic acids, and key biochemical tests.
3. **Explain** enzyme action and regulation, metabolic pathways (urea cycle, heme), and roles of nucleic acids in therapy and diagnostics.
4. **Analyze and differentiate** types of proteins, amino acids, enzymes, and metabolic disorders. Analyze clinical test variations.
5. **Evaluate** clinical importance of biomolecules and interpret lab results in disease conditions.
6. **Design** simple experiments for enzymes and basic diagnostic approaches.
7. **Apply** biochemical knowledge to drug action, metabolism, and clinical analysis.
8. **Demonstrate** understanding through problem-solving and interpretation of biochemical and clinical data.

Course Content (Theory)		**Assignments/Readings**
Week 1	Introduction to Proteins and amino acid	Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of
	Classification of Proteins and amino acid	

	Physical and chemical properties of Proteins	biochemistry (7th ed.). W. H. Freeman and Company. **Assignment:** Define proteins. Classify different types of amino acids.
Week 2	Organizational level of proteins Pharmaceutical applications of proteins Digestion of proteins	Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of biochemistry (7th ed.). W. H. Freeman and Company. **Assignment:** Write down in detail therapeutic applications of proteins.
Week 3	Metabolism of essential amino acids Metabolism of non-essential amino acids Metabolic disorders of biosynthetic pathway	Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press. **Assignment:** Practice metabolic pathways with structures.
Week 4	Urea cycle and disorders Heme synthesis Heme degradation and disorders	Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press. **Assignment:** Practice metabolic pathways with structures.
Week 5	Introduction to Nucleic acids Purine bases Pyrimidines bases	Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press. **Assignment:** Practice structures of bases.
Week 6	Gene therapy Use of nucleic acids in gene therapy Drug delivery	Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press. **Assignment:** Make a list of nucleic acids used in gene therapy.
Week 7	Diagnostics Introduction to Vaccines Types and medical applications of vaccines	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley.

		Assignment: Enlist vaccines used in Pakistan.
Week 8	Introduction to targeted therapies Introduction to antisense therapies Introduction to bioanalysis	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Compare targeted, antisense therapy and bioanalysis.
Week 9	Introduction to nanotechnology Types of nanotechnological products Pharmaceutical applications of nanotechnological products	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Enlist nanotechnological products available in market.
Week 10	Introduction to enzymes Classification of enzymes Activation of enzymes	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Attempt quiz from the covered lesson
Week 11	Inhibition of enzymes Specificity of enzymes	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Attempt quiz from the covered lesson
	Allosteric enzymes	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley.

		Assignment: Define enzymes and explain concept of activation and inhibition of enzymes.
Week 12	Factors affecting rate of enzyme-catalyzed reaction	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley.
	Drug-enzyme interactions Pharmaceutical importance of enzymes	Gout, A. M. (2019). Biochemistry for the pharmaceutical sciences (4th ed.). Wiley. **Assignment:** Attempt quiz from the reactions covered
Week 13	Introduction to Coenzymes Coenzymes role in the regulation of metabolic processes. Secondary Messengers	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Attempt quiz from the reactions covered
Week 14	Types of Secondary Messengers Role of cAMP Role of Calcium ions	Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley. **Assignment:** Attempt quiz and prepare a poster on a chart paper.
Week 15	Role of phosphoinositol Introduction to clinical biochemistry Importance of clinical biochemistry	Devlin, T. M. (2016). Textbook of biochemistry with clinical correlations (8th ed.). Wiley-Liss. **Assignment:** Prepare a poster on normal ranges of uric acid , cholesterol, bilirubin and creatinine
Week 16	Laboratory tests in diagnosis of diseases including uric acid Laboratory tests in diagnosis of diseases including cholesterol Laboratory tests in diagnosis of diseases including bilirubin and creatinine	

Textbooks and Reading Material

Main source: Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). Stryer's biochemistry (8th ed.). W. H. Freeman and Company.

Other sources: Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.

1. Nelson, D. L., & Cox, M. M. (2017). Lehninger principles of biochemistry (7th ed.). W. H. Freeman and Company.
2. Abraham, D. J. (2017). Burger's medicinal chemistry and drug discovery (8th ed.). Wiley.
3. Devlin, T. M. (2016). Textbook of biochemistry with clinical correlations (8th ed.). Wiley-Liss.
4. Gout, A. M. (2019). Biochemistry for the pharmaceutical sciences (4th ed.). Wiley.
5. Berg, J. M., & Stryer, L. (2020). Biochemistry (9th ed.). W. H. Freeman and Company
6. Hodges, R. S. (2019). Biochemistry: A short course (3rd ed.). Wiley.

Course content (Practical/lab)

1. Qualitative analysis of lipids
2. Qualitative analysis of oils
3. Qualitative analysis of Cholesterol
4. Qualitative analysis of Urea
5. Qualitative analysis of Uric acid
6. Qualitative analysis of Bile salts
7. Analysis of milk
8. Quantitative estimation of glucose by Benedicts Method
9. Quantitative estimation of glycine by Sorenson's Method
10. Quantitative estimation of ascorbic acid by Iodometric Method
11. Quantitative estimation of creatinine by Spectroscopic Method
12. Quantitative estimation of uric acid by Spectroscopic Method
13. Quantitative estimation of cholesterol by Spectroscopic Method

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.

2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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University of the Punjab, Lahore

Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	PHARM-117 (Theory), PHARM-118 (Lab)	**Credit Hours**	2+1
Course Title	Anatomy and Histology				

Course Introduction

Anatomy and Histology are fundamental subjects in medical and biological sciences that provide essential knowledge about the structure of the human body from the macroscopic to the microscopic level. This course is designed to introduce students to the organization of the body and the detailed study of tissues that form organs and systems.

Anatomy is the study of the gross structure of the human body, including organs, muscles, bones, and body systems. It helps students understand the location, shape, and relationships of body parts, as well as how these structures function together to maintain health.

Histology is the study of microscopic tissues and cells. It focuses on the detailed structure of epithelial, connective, muscular, and nervous tissues, and how these tissues combine to form organs. Histology provides insight into the cellular organization necessary for normal body function.

Throughout this course, students will study major body systems such as the skeletal, muscular, circulatory, respiratory, digestive, urinary, reproductive, and nervous systems, while also examining the microscopic structure of tissues associated with each system. Practical learning may include the use of microscopes, tissue slides, and diagrams to identify different cells and tissue types.

By the end of the course, students will be able to describe major anatomical structures, recognize the basic tissue types, understand the relationship between tissue structure and function, and apply this knowledge in medical and laboratory sciences.

Learning Outcomes

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

1. **Identify** and describe the anatomy of the thoracic region, including the skeletal, respiratory, and cardiovascular structures
2. **Understand** and explain the positions, structures, and functions of the major abdominal organs and related systems.
3. **Demonstrate** knowledge of the structures and functions of the urinary system, limbs, and nervous system, including the spinal cord, brain, cranial nerves, eye, and ear.
4. **Explain** histological techniques and their pharmacological relevance in the context of tissue analysis and drug interactions.

Course Content (Theory)		Assignments/Readings
Week 1	Anterior and posterior aspects of the heart The coronary arteries and veins	Standring, S. (Ed.). (2020). Gray's anatomy: The anatomical basis of clinical practice (42nd ed.). Elsevier **Assignment:** learn about coronary arteries and veins with practice of diagrams
Week 2	The coronary arteries and veins Heart chambers,	**Learning:** Practice the diagram of heart with proper labelling
Week 3	Mediastinum Positions of liver, spleen, gall bladder in the abdominal cavity.	Tortora's Principles of Anatomy & Physiology Textbook by Bryan H. Derrickson and Gerard J. Tortora **Assignment:** Practice and learn about positions of these organs with diagram
Week 4	Positions pancreas, stomach and kidney in the abdominal cavity. Gross anatomy of stomach, intestine,	Tortora's Principles of Anatomy & Physiology Textbook by Bryan H. Derrickson and Gerard J. Tortora
Week 5	Gross anatomy of liver, spleen, gall bladder, pancreas, and kidney Gross anatomy of stomach, intestine, liver, spleen, gall bladder, pancreas, and kidney	**Assignment:** attempt quiz of covered syllabus
Week 6	The portal system of veins The biliary duct system	**Learning:** learn about hepatoportal system
Week 7	Gross anatomy of brain Gross anatomy of spinal cord	Chung, K. W., Chung, H. M., & Halliday, N. L. (2015). Gross anatomy (8th ed.). Lippincott Williams & Wilkins **Assignment:** attempt quiz of covered topics
Week 8	Names of the cranial nerves and their specific functions. Names of the cranial nerves and their specific functions.	
Week 9	Gross anatomy of eye Gross anatomy of ear	**Learning:** Cover and practice labeled diagram of ear and eye
Week 10	The thoracic cage The thoracic vertebrae	Morton, D. A., Foreman, K. B., & Albertine, K. H. (2011). The big picture: Gross anatomy. McGraw-Hill.
Week 11	The ribs, sternum, diaphragm	

	Lobes and fissures of lungs	**Learning:** practice the labeled diagrams of thoracic region
Week 12	Lobes and fissures trachea	Morton, D. A., Foreman, K. B., & Albertine, K. H. (2011). The big picture: Gross anatomy. McGraw-Hill
	Lobes and fissures of bronchi	**Assignment:** Attempt quiz of covered topics
Week 13	Gross anatomy of the pharynx and larynx	Tortora's Principles of Anatomy & Physiology Textbook by Bryan H. Derrickson and Gerard J. Tortora **Assignment:** Attempt quiz of covered topics
	Gross anatomy of bones	
Week 14	Gross anatomy of the joints of upper limbs	
	Gross anatomy of joints of lower limbs	
Week 15	Overview of histological techniques like tissue fixation, embedding, sectioning, staining, and microscopy	**Learning**: Learn about these techniques using internet platform
	Overview of histological techniques like tissue fixation, embedding, sectioning, staining, and microscopy	
Week 16	Pharmacological relevance of histology	
	Pharmacological relevance of histology	

Textbooks and Reading Material

Main source: Tortora's Principles of Anatomy & Physiology. Textbook by Bryan H. Derrickson and Gerard J. Tortora

Other sources:

- Agur, A. M. R., & Dalley, A. F., II. (2024). Moore's Essential Clinical Anatomy (7th ed.). Lippincott Williams & Wilkins.
- Chung, K. W., Chung, H. M., & Halliday, N. L. (2015). Gross anatomy (8th ed.). Lippincott Williams & Wilkins
- Dalley, A. F., II, & Agur, A. M. R. (2023). Moore's Clinically Oriented Anatomy (9th ed.). Lippincott Williams & Wilkins.
- Drake, R. L., Vogl, A. W., & Mitchell, A. W. M. (2023). Gray's Anatomy for Students (5th ed.). Elsevier.
- Ellis, H., & Mahadevan, V. (2010). Clinical anatomy: Applied anatomy for students and junior doctors (10th ed.). Wiley-Blackwell.
- Gartner, L. P., & Lee, L. M. J. (2023). Gartner & Hiatt's Atlas and Text of Histology (8th ed.). Lippincott Williams & Wilkins.
- Morton, D. A., Foreman, K. B., & Albertine, K. H. (2011). The big picture: Gross anatomy. McGraw-Hill.
- Ross, M. H., & Pawlina, W. (2023). Histology: A Text and Atlas with Correlated Cell and Molecular Biology (9th ed.). Lippincott Williams & Wilkins.
- Standring, S. (Ed.). (2020). Gray's anatomy: The anatomical basis of clinical practice

(42nd ed.). Elsevier.

Course content (Practical/lab)

1. Understand thoracic anatomy including the thoracic cage, diaphragm, and lung structures etc.
2. Study the cardiac morphology encompassing external and internal structures of the heart and associated vasculature.
3. Identify the abdominal organ positions and structures of the liver, spleen, gall bladder, pancreas, stomach, and kidneys using anatomical models.
4. Examine urinary system components including kidney, ureter, bladder, and urethra.
5. Study male and female reproductive system anatomy.
6. Analyze the bones and joints of upper limbs
7. Analyze the bones and joints of lower limbs
8. Examine brain structures including lobes, ventricles, and brainstem.
9. Study spinal cord anatomy with regional differentiation, vertebrae, and grey/white matter.
10. Identify the anatomical structure of human eye and ear
11. Perform tissue Fixation of rat liver and kidney specimen using 10% neutral buffered formalin for subsequent histopathological analysis.
12. Identify key microscopic features of common histological findings in tissues as different types of epithelial tissues, connective tissues. (Loose and dense connective tissues), cartilages, bone (Compact and spongy bone), digestive system (Esophagus, stomach, small intestine), liver, lymphatic system (Lymph nodes, spleen, thymus), excretory system. (Kidneys /glomerulus, ureters and urinary bladder), respiratory system (Bronchi and alveolus), endocrine system (pituitary gland, thyroid gland, adrenal gland), reproductive system (seminiferous tubules/ testes, ovary, mature follicle).

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.

3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	PHARM-119 (Theory), PHARM-120 (Lab)	**Credit Hours**	3+1
Course Title	Physiology-II				

Course Introduction

Physiology is the branch of biological science that studies the normal functions and mechanisms of the human body. This course is designed to provide students with a comprehensive understanding of the functional processes that occur within the body.
Students will learn how the body responds to internal and external changes through coordinated activities of different organs and systems.
Major topics covered in this course include the functions of the circulation, respiratory, endocrine, urinary, reproductive, and immune systems. Emphasis is placed on understanding how these systems interact to maintain balance and support normal body activities.
Practical applications of physiology will help students relate theoretical concepts to real-life health conditions, body responses, and clinical situations. Students may also study basic experiments, measurements, and physiological processes in laboratory settings.

Learning Outcomes

On the completion of the course, the students will be able to:
1. **Explain** the structure, formation, and functions of blood components, describe the process of blood clotting and blood typing, and relate these to common disorders like anemia and leukopenia.
2. **Describe** the structure and function of the circulatory and lymphatic systems, including blood vessels, and explain how blood pressure is regulated.
3. **Explain** how the respiratory system works, including gas exchange, breathing control, and the different lung volumes and capacities.
4. **Describe** kidney function and urine formation, and explain how the body maintains fluid, electrolyte, and acid-base balance.
5. **Explain** the physiology of the male and female reproductive systems, including gamete formation, the menstrual cycle, and stages such as puberty, pregnancy, and menopause.

Course Content (Theory)		**Assignments/Readings**
Week 1	Mechanisms of body temperature regulation	Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X. J. (2019). Ganong's review of medical physiology (26th ed.). McGraw-Hill Education.
	Mechanisms of body temperature regulation	
	Pathophysiology fever and hypothermia	
Week 2	The blood cells	Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier
	Red blood cells, erythropoiesis	
	Formation and destruction of hemoglobin	

Week 3	Types of white blood cells, genesis of white blood cells	Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier
	Roles of different white blood cells, types of T-cells and their functions, B-cells and memory cells	
	Antibodies, formation of pus, anemia and leukopenia	
Week 4	Platelets, formation of platelet plug, mechanism of blood coagulation	**Assignment:** Prepare full chapter for assignment
	Extrinsic and intrinsic pathways of initiating clotting, lysis of blood clot	
	Blood types, agglutinogens, Rh blood types, plasma, serum.	
Week 5	Circulation, Basic theory of circulatory function	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education
	Structure and function of blood vessels (arteries, arterioles, capillaries, veins),	
	Blood pressure, total peripheral vascular resistance	
Week 6	Total pulmonary vascular resistance	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education
	Clinical methods of measuring systolic and diastolic blood pressures	
	Arterial pressure and baroreceptor reflex	
Week 7	Renin-angiotensin system	**Assignment:** attempt quiz from covered topics
	Hematocrit, lymph channels of the body	
	Formation of lymph	
Week 8	Respiratory Physiology, Physiological anatomy of lungs	Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers
	Mechanism of inspiration and expiration	
	Definitions of various lung volumes and capacities	
Week 9	Exchange of gases in alveoli and tissues,	
	Transport of oxygen in blood, transport of carbon dioxide in Blood	
	Transport of hydrogen ions between tissues and lungs	Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers
Week 10	Regulation of respiration,	**Assignment:** Attempt quiz from the covered lesson
	Pulmonary edema, pleural effusion	
	Non-respiratory functions of the Lungs.	

Week 11	Renal physiology Physiological anatomy of kidney and nephron	Firdaus, M. (2021). Firdaus review of physiology: Included MCQs and viva (21st ed.). Riaz Medical Publishers
	Functions of the kidney	
	Urine formation, formation of dilute and concentrated urine	
Week 12	Glomerular filtration, glomerular filtration rate (GFR),	Firdaus, M. (2021). Firdaus review of physiology: Included MCQs and viva (21st ed.). Riaz Medical Publishers
	Mechanisms of tubular reabsorption and secretion	
	Micturition, buffering of H+ ion	
Week 13	Renal sodium regulation	**Assignment:** Attempt quiz from the reactions covered
	Renal potassium regulation	
	Renal water regulation	
Week 14	Endocrine and Reproductive Physiology .	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education
	Physiological roles of hormones secreted from major endocrine glands	
	Pituitary gland	
Week 15	Thyroid gland	**Assignment**: Attempt quiz from the reactions covered
	Adrenal gland	
	Pancreatic gland	Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education.
Week 16	Reproductive physiology including gametogenesis	
	Menstrual cycle regulation	
	Life-stage transitions	

Textbooks and Reading Material

Main source: Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The mechanisms of body function (16th ed.). McGraw-Hill Education**.**

Other sources:

1.Barrett, K. E., Barman, S. M., Brooks, H. L., & Yuan, J. X. J. (2019). Ganong's review of medical physiology (26th ed.). McGraw-Hill Education.
2.Costanzo, L. S. (2024). BRS physiology (7th ed.). Wolters Kluwer
3.Firdaus, M. (2021). Firdaus review of physiology: Included BCQs and viva (21st ed.). Riaz Medical Publishers.
4.Hall, J. E. (2021). Guyton and Hall textbook of medical physiology (14th international ed.). Elsevier.
5.Sembulingam, K., & Sembulingam, P. (2022). Essentials of medical physiology (9th ed.). Jaypee Brothers Medical Publishers
6.Sherwood, L. (2016). Human physiology: From cells to systems (9th ed.). Cengage Learning.
7.Wecker, L., & Ingram, S. L. (2024). Brody's human pharmacology: Mechanism-based therapeutics (7th ed.). Elsevier.
8.Widmaier, E. P., Raff, H., & Strang, K. T. (2023). Vander's human physiology: The

mechanisms of body function (16th ed.). McGraw-Hill Education.

Course content (Practical/lab)

At the end of this course the student will be able to:

1.Determine the Hemoglobin (Hb) content in human blood
2.Determine the erythrocyte sedimentation rate (ESR) in human blood
3.Determine the red blood cell count in human blood
4.Determine the bleeding time in human blood
5.Determine the coagulation time in human blood
6.Determine an individual's blood type using anti-sera for ABO and Rh typing.
7.Determine the lung tidal volume, inspiratory reserve volume, expiratory reserve volume and vital capacity.
8.Measure and record changes in respiratory rate and oxygen saturation under different conditions (e.g., at rest vs. after exercise).
9. Learn the technique of nebulization using normal saline as the nebulizing solution.
10. Learn cardiopulmonary resuscitation (CPR) technique using CPR manikin or dummy.
11.Demonstrate the importance of vector control in preventing the spread of dengue fever
12. Understanding pre-recorded heart and lung sounds

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
			Quiz 2 (pre-mid)	Week 7
Assignment 2 (Post-mid)	Week 11		Quiz 3 (post-mid)	Week 10
			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

Punjab University College of Pharmacy
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Course Outline

Programme	Pharm.D 2nd Semester	**Course Code**	IS-121	**Credit Hours**	2
Course Title	Islamic Studies				

Course Introduction

This course provides basic information about Islamic Studies. To enhance understanding of the students regarding Islamic Civilization. History of Islam, understanding of the worship and its usefulness. The basic concept of Quran Pak: wisdom, patience, loyalty. The comparative analysis of Islam with other religions. The concept and value of ***Haqooq ul Ibad*** (Bandon Kay Haqooq) in Islam. What are the rights of people in Islamic Point of View. Islamic point of view about other religions.

Learning Outcomes

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

1. To further enhance the knowledge of Islam.
2. To understand the basic concept of Islam and Quran Pak.
3. To understand the concept of Haqooq ul ibad in the light of Quran.
4. To know the importance of Islamic concept about other religions.

Course Content (Theory)		
Week 1	Introduction to Islamic vision of life What is meaningful life? Understanding the Purpose /Way of Life. What is the Islamic vision of life?	
Week 2	Verse of Surah Al-Baqra Related to faith (284-286) Hadith No 1. Importance of study of (Seerah) life of Holy Prophet (PBUH)	
Week 3	Verse of surah AL-Anam Related to AHKAM (152-154) Hadith No 2+3	
	Migration to Madina causes, reason and events.	
Week 4	Verse of surah al-Ahzaab related to Adaab-i-Nabvi and value of holly Prophet (PBUH) (6, 21, 40) Hadith No 4	
	Importance of migration to Madina	

Week 5	Verse of surah al-Ahzaab related to Adaab-i-Nabvi and value of holly Prophet (PBUH) (56, 57, 58) Hadith No 5	
	Treaty of Hudaibiya complete	
Week 6	Verse of surah AL-Hashr related to thinking, Day of judgement (18,19,20) Hadith No 5	
	Last Pilgrimage with last semen	
Week 7	Verse of Surah Al-Furqan related to social ethics (63 to 70) Hadith No 7	
	Sources of Islamic laws jurisprudence	
Week 8	Verse of Surah Al-Furqan related to social ethics (71 to 77)	
	Hadith No 8	
Week 9	Verse of surah Al-Muminoon related to characteristics of faithful (1-6) Hadith no 9	
	Life of prophet (PBUH) before prophethood	
Week 10	Verse of surah Al-Muminoon related to characteristics of faithful (7-11) Hadith no 10	
	Characteristics of Islamic culture and civilization	
Week 11	Verse of surah Al- Hujurat related to Adaab-i-Nabvi (1-6) Hadith no 11+12	
	Measure of distribution of wealth in Islamic economics.	
Week 12	Verse of surah Al- hujurat related to Haqooq-ul-ibad (11,12,13) Hadith No 13	
	Islamic way of trade and commerce	
Week 13	Verse of Surah Al-Isra related to Haqooq-ul-ibad (26,31,33,34,35) Hadith No 14	
	Islamic History: Period of khulfa-e Rashide	
Week 14	Verse of surah Al-Saf related to Tafakkur-o-Tadabbur (1-5) Hadith No 15	
	The Islamic Concept of Other Religions	

Week 15	Verse of surah Al-Saf related to Tafakkur-o-Tadabbur (6-10) Hadith No 16	
	Introduction of hadith Kinds of hadith	
Week 16	Verse of surah Al-Saf related to Tafakkur-o-Tadabbur (11-14) Hadith No 17	
	Islamic concept Sovereignty	

Textbooks and Reading Material

Main source: Mehmood A. Islamiyat (Compulsory) Allied Book Centre, Lahore.

Other sources:

1. Introduction to Islam by Dr Hamidullah, Papular Library Publishers Lahore
2. Principles of Islamic Jurisprudence by Ahmad Hassan, Islamic Research Institute, IIUI
3. Mazharul H. **A short History of Islam,** Book Land Publisher, Lahore

Assignments: Types and Number with Calendar

Assignment/presentation (20 marks)			**Class quiz (30 marks)**	
No.	**Week**	**Deadline for submission**	**No.**	**Week**
Assignment 1 (Pre-mid)	Week 3	Within the timeline assigned by the teacher	Quiz 1 (pre-mid)	Week 4
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			Quiz 4 (post-mid)	Week 14

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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Checklist for a New Academic Program

Parameters	YES/NO
1. Department Mission and Introduction	YES ☐ NO ☐
2. Program Introduction	YES ☐ NO ☐
3. Program Alignment with University Mission	YES ☐ NO ☐
4. Program Objectives	YES ☐ NO ☐
5. Market Need/ Rationale	YES ☐ NO ☐
6. Admission Eligibility Criteria	YES ☐ NO ☐
7. Duration of the Program	YES ☐ NO ☐
8. Assessment Criteria	YES ☐ NO ☐
9. Courses Categorization as per HEC Recommendation	YES ☐ NO ☐
10. Curriculum Difference	YES ☐ NO ☐
11. Study Scheme / Semester-wise Workload	YES ☐ NO ☐
12. Award of Degree	YES ☐ NO ☐
13. Faculty Strength	YES ☐ NO ☐
14. NOC from Professional Councils (if applicable)	YES ☐ NO ☐

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Program Coordinator **Chairperson**