Catalogue 2026

Undergraduate Program

Faculty of Pharmacy and Pharmaceutical Sciences
University of Karachi

Celebrating 60 years of legacy and leadership

Ranked among the top

150–200

pharmacy faculties worldwide

- Set the benchmark for pharmacy education and institutional development
- Pioneering force behind the foundation of number of pharmacy colleges and faculties, shaping the nation's pharmaceutical education landscape.
- Spearheading curriculum development and academic leadership nationwide.

1964

ESTABLISHED

over 60 years of academic & research excellence

1973

First Faculty of Pharmacy in Pakistan

One of the **largest and oldest faculties** in Pakistan in terms of area, infrastructure, and enrollment.

1996

RIPS

Research Institute of Pharmaceutical Sciences (RIPS), promoting advanced and collaborative pharmaceutical research.

over

13000

graduates contributing globally in academia, pharmaceutical industries, hospitals, community pharmacy, and regulatory sectors.

Around

2000

students study in undergraduate and postgraduate programs annually, reflecting strong academic capacity.

- Alumni network shaping pharmacy education and research across Pakistan

To sustain its role as a center of excellence in pharmaceutical education and research, promoting innovation, scientific collaboration, and global impact in health sciences

Faculty comprises of

Highly Qualified

PhD holders from reputed institutions, bringing extensive academic, research, and professional experience.

Research Excellence

Thousands of research papers published in national and international journals.

Number of books on various topics authored by the faculty.

Faculty publishes two leading journals

Pakistan Journal of Pharmaceutical Sciences (PJPS) an impact factor journal established in

1988

advancing global editorial excellence

Pakistan Journal of Pharmacology, established in

1985

BBRF

Bioavailability and Bioequivalence Research Facility (BBRF), offering bioavailability and regulatory testing for national and multinational industries.

2016

2024

TIBBE-E-NABAVI (SAW) RESEARCH LAB

Tibbe-E-Nabavi (SAW) Research Lab of Herbal Drugs and Cosmeceuticals

Purpose-built, spacious

Academic Buildings

provide an environment that supports effective student learning

Catalogue 2026

Undergraduate Program

FACULTY OF PHARMACY AND PHARMACEUTICAL SCIENCES
University of Karachi, Karachi-75270

In the Name of Allah, the Most Beneficent, the Most Merciful

The catalogue 2026 provides criteria for selection of students, detailed syllabi of prescribed courses, schedule of teaching, protocol for examinations, grading system, and conditions for the award of degree. Introduction of the departments, introduction of the faculty members, facilities available, details of co-curricular activities etc.

Students are advised to read it carefully and act accordingly so as to get acquainted with all the necessary information with respect to their faculty and profession.

Only those fear Allah, from among His servants, who have knowledge.

Surah Fatir, Verse 28

"Are those who know equal to those who do not know?" Only they will remember [who are] people of understanding.

Surah Zumar, Verse 9

Advice of the Quaid

"My young friends, I look forward to you as the real makers of Pakistan. Do not be exploited and do not be misled. Create amongst yourself complete unity, solidarity and discipline. I assure you: "Divided you fall, United you stand". Set an example of what youth can do. If you fritter away your energies now, you will always regret. You must now realize that fresh fields, new channels and avenues are now being thrown open to you, where you have unlimited opportunities, namely, you must now direct your attention to science, commercial banking, insurance, industry and technical education. After you leave the portals of your universities and colleges then you can play your part freely and help yourself and the state".

March, 1948

Quaid e Azam Mohammad Ali Jinnah

M.A. Jinnah

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Message

The Vice Chancellor, University of Karachi

It is my great pleasure to welcome all our newly admitted students to the distinguished institution of Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. As Vice-Chancellor, I extend warm greetings to each of you for this transformative chapter in your academic journey.

You have joined University of Karachi having a sound history of decades, massive contribution in generating human resources serving across the globe. Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi is among top 200 Universities by QS world Ranking by subject (Pharmacy and Pharmacology) and is committed to excellence in teaching, imparting advancement in research, and service. Here, you will find a vibrant community of scholars, dedicated faculty members, and supportive administrative staff who are all invested to shape up your professional career. I am pleased to announce that we have adapted the NCRC-HEC/PCP revised curriculum of Pharm D which was notified in 2025 for implementation in 2026. It is a moment of pride to me that our leading faculty members actively participated for the revision of Pharm D curriculum in National Curriculum Revision Committee (NCRC), Higher Education Commission of Pakistan (HEC). The Pharm D curriculum will equip you more efficiently with the knowledge, skills, and values needed to thrive in an increasingly complex and dynamic world.

I am pleased to know that the Faculty of Pharmacy and Pharmaceutical Sciences is publishing a Catalogue, which is more than a document—it is a guide to the opportunities that await you. Within its pages, you will find information that will help you navigate your studies, understand our academic expectations, and make the most of the diverse resources available. This Catalogue is a source of all the first-hand information that a newcomer would like to know. I am sure that the students will be benefitted with all this information and hope that they would abide by all the necessary rules and regulations.

I congratulate Prof Dr. Muhammad Harris Shoaib, Dean Faculty of Pharmacy and Pharmaceutical Sciences and his energetic team for their dedication and commitment towards the upgradation of the Faculty and the Students.

Prof. Dr. Khalid Mahmood Iraqi

The Vice Chancello

Message

The Dean, Faculty of Pharmacy and Pharmaceutical Sciences University of Karachi

It is with great pleasure and pride that I welcome the 2026 batch to the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, for the academic year 2026. This year marks the beginning of an exciting journey of Pharm D to your life, where your curiosity will born new ideas and your dedication will transform into possibilities. Doctor of Pharmacy (Pharm D) is a profession committed to advancing the health care system, pharmaceutical care, and shaping the future of patient care through pharmaceutical technology.

Our faculty is a distinguished and proud legacy of over six decades of academic excellence, pioneering research, and exceptional dedication to producing leaders in pharmaceutical sciences across the globe. We continuously evolve our curriculum and training approaches to meet the dynamic needs of the pharmaceutical industry and the healthcare system, equipping you with the knowledge, skills, and ethical grounding necessary to excel as a modern pharmacist in Pakistan and beyond. The Higher Education Commission (HEC) Pakistan has notified the curriculum 2025 of the Pharm D program, revised by the Pharmacy Council of Pakistan. The Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi is well-equipped to fulfil all the curricular requirements devised by the Pharmacy Council of Pakistan. Your batch is privileged to learn the advanced content catering to the national and international needs of the field. The students for the first time will particulate in the multifaceted capstone projects/ experiential learning program (ELP) mentored by the faculty members with industrial, hospital and community linkages. Moreover, you will learn from experienced faculty, engage in innovative research, and develop practical expertise through intensive laboratory training, industry-oriented curricula and exposure to pharmacy practice. There are many beyond the classroom co-curricular activities, I encourage you to embrace the University's vibrant campus life—participating in student clubs and societies, professional events, and activities that will enrich your personal and professional growth.

The journey ahead is both challenging and rewarding, and I am proud of my distinguished faculty members that will help you in directing your career path with full commitment. Remember, every step you take here is shaping you into a capable, compassionate, and forward-thinking professional who will make a tangible difference in people's lives.

On behalf of the faculty and staff, I welcome you once again to the Faculty of Pharmacy and Pharmaceutical Sciences. We look forward to supporting and guiding you as you pursue excellence in your academic, professional, and personal endeavors.

Wishing you a successful and inspiring journey ahead.

Prof. Dr. Muhammad Harris Shoaib

The Dean
Faculty of

INTRODUCTION:
UNIVERSITY OF KARACHI

The University of Karachi was established in 1951 under a charter of the Central Government. Until 1959, it was housed in a rented building situated in a congested area of the city. In 1960, it was relocated to the present campus, sprawling over an area of nearly two square miles. The campus has since been growing steadily. In its present state, it affords many facilities to the students and strives hard with a vision to become a modern, well-equipped University town for the students that their successors will be proud of.

Altogether over 25,000 regular students are enrolled in 58 departments functioning under 9 faculties: Arts, Science, Engineering, Administrative and Management Sciences, Education, Islamic Learning, Law, Pharmacy and Pharmaceutical Sciences, and Medicine as well as 20 research institutes and centers. More than 150 colleges are affiliated with the University, and therefore University of Karachi is an affliating, examining and teaching body, and hence caters to the teaching requirement of over 25 million population of the city.

The University has the best teaching staff consisting of more than 800 teachers. Most of the teachers are highly qualified, having Ph.D. and D.Sc. degrees from Pakistan and abroad, and out of them, some are of international fame. University, being located in the port city of Karachi, serves as the window of higher education in Pakistan. The University has acquired a high status in the field of education in Pakistan as well as abroad within a span of 70 years. Presently it occupies a prominent place especially in teaching and research in Science, Pharmacy, Administrative and Management Sciences and Medicine.

The University, on its part, provides good facilities to promote learning. The University library, for instance, is stocked with the latest books in various fields and is virtually a storehouse of information.

A university is a seat of learning; its primary aim is to promote the pursuit of knowledge. Examination and degrees play only a secondary role in its functions. The development of students' minds and character are the lasting acquisitions; the value of degrees and diplomas is only ephemeral.

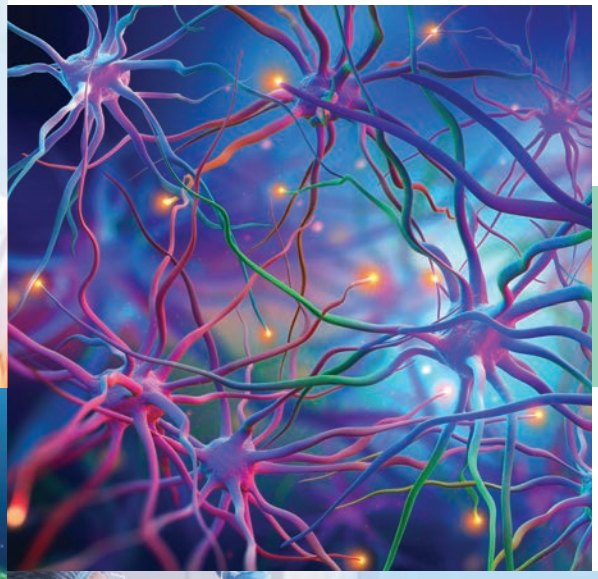
There are facilities for sports of all kinds to enable the students to develop a spirit of healthy competition. The University gymnasium offers the student ample opportunities to develop their physique, because a healthy mind can reside only in a healthy body.

Beside subject arcades and clubs, there are forums for free and unfettered exchange of views among students. It also helps to foster a spirit of cooperation and offers good training in civic responsibilities. It is a platform for healthy discussion, and while participating in its activities one must see that one should not overstep the limits by indulging in irresponsible and destructive talks and activities. All co-curricular activities are intended to make students' lives richer by increasing their contacts with their fellow students and teachers.

The campus, however, represents only one aspect of the University; the other and more important aspect is the cooperation between the students and the teachers which alone can create a healthy academic atmosphere in the University conducive to learning. Education is a two-way process and it can be accomplished only if the teacher and the student both actively participate in it. Remember that the keenness of the teacher to give is always proportional to the keenness of the student to receive; meaning that the students must bring a good deal of earnestness and enthusiasm to bear upon their studies if they want to reap the maximum benefit from their stay in the University.

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Faculty of Pharmacy and Pharmaceutical Sciences



Faculty of Pharmacy and Pharmaceutical Sciences

The Faculty of Pharmacy and Pharmaceutical Sciences of the University of Karachi owes its origin from the Department of Pharmacy, which was established in 1964. The Department of Pharmacy in this university was founded in response to the need for a better drug delivery system in hospital and retail pharmacy, and also to cater the ever-growing need of the pharmaceutical industry, as 90 percent of the drug-based industry in Pakistan, both national and multinational, are located at Karachi. The development of pharmacy education at the University of Karachi was very rapid, and in a very short span of time it occupied a prominent position as the largest pharmacy teaching institution, and has made a significant contribution in the development of the pharmaceutical industry. The erstwhile Department of Pharmacy was raised in 1973 into a full-fledged and the first Faculty of Pharmacy in the country which at that time was comprised of 4 teaching and research departments, such as: Pharmaceutics, Pharmaceutical Chemistry, Pharmacology and Pharmacognosy. In 2004 the 4-year B-Pharm degree was replaced by a 5 years Pharm-D degree program on the recommendation of the Pharmacy Council of Pakistan and Higher Education Commission. As a consequence to this, a fifth department of Pharmacy Practice was launched in 2015. Around 2000 regular students are today pursuing their studies leading to the award of Doctor of Pharmacy (Pharm. D.), Master of Philosophy (M.Phil.), and Doctor of Philosophy (Ph.D.) degrees.

The Faculty of Pharmacy and Pharmaceutical Sciences has so far produced around 13000 B.Pharm. /Pharm. D., and more than 900 post graduates. This constitutes the largest figure of graduates and post graduates from any pharmacy institution of the country. Moreover, the faculty published thousands of research papers in national and international journals. The Faculty of Pharmacy and Pharmaceutical Sciences has well equipped laboratories in all the departments, which fully cater to the teaching and research needs of the various degree programs. Moreover, there is a good library with an e-library and internet facility. The faculty took another step forward to establish an Institute of Pharmaceutical Sciences under its auspices so as to give more impetus to scientific and technological research and development. This institution has been recently renovated and re-designed keeping in view the current demands of the field.

To cater to the increasing number of students, new buildings for each department, a separate building for the Dean office work were constructed and have been operational since 2015. The Faculty of Pharmacy and Pharmaceutical Sciences of the University of Karachi, in keeping with its tradition and its accomplishments, will continue to carry out its mission as a leading institution to excel higher learning in pharmaceutical sciences in Pakistan.

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email: **deanpharm@uok.edu.pk**
website: **https://www.uok.edu.pk/faculties/index.php#phm**

Faculty of **Pharmacy and Pharmaceutical Sciences**

Vision

As an epitome of pharmacy research and innovation, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi envisions transforming pharmacy education and research to health care service. Our core vision is to prepare leading pharmacists and pharmacy graduates who will be able to compete globally and be socially responsible to drive advanced patient care. We are working with the vision to inspire our upcoming generation and to expand the perimeter of pharmacy practice and pharmaceutical sciences.

Mission

Our faculty is committed to fostering an innovative academic environment, and effectuate to prepare competent and compassionate professionals well equipped with pharmacy knowledge, skills, and ethical values. University of Karachi is a leading institution in pharmacy and pharmaceutical sciences, providing quality education and training for decades. We are passionate to respond to the evolving local and global needs of the pharmacy profession through collaborative partnership with health care set ups and pharmaceutical manufacturers. We strive to prepare our pharmacy graduates to remarkably contribute to public health and pharmaceutical sciences.

Board of Faculty

Prof. Dr. Muhammad Harris Shoaib
Dean
Faculty of Pharmacy & Pharmaceutical Sciences
University of Karachi

Prof. Dr. Zaheer Qasmi
HEJ Research Institute of Chemistry
University of Karachi

Prof. Dr. Tanveer Abbas
Department of Microbiology
University of Karachi

Prof. Dr. Shamim A. Qureshi
Chairperson, Department of Biochemistry
University of Karachi

Prof. Dr. Nousheen Mushtaq
Department of Pharmaceutical Chemistry
University of Karachi

Prof. Dr. Muhammad Mohtasheem ul Hasan
Chairman
Department of Pharmacognosy
University of Karachi.

Prof. Dr. Syeda Afroz
Department of Pharmacology
University of Karachi

Prof. Dr. Afshan Siddiq
Department of Pharmacology
University of Karachi

Prof. Dr. Sohail Hassan
Department of Pharmaceutical Chemistry
University of Karachi

Prof. Dr. S.M. Farid Hassan
Chairman
Department of Pharmaceutics
University of Karachi

Prof. Dr. Rabia Ismail Yousuf
Department of Pharmaceutics,
University of Karachi.

Prof. Dr. Iyad Naeem Mohammad
Coordinator
Department of Pharmacy Practice
University of Karachi

Prof. Dr. Asia Naz
Chairperson
Department of Pharmaceutical Chemistry
University of Karachi

Prof. Dr. Safila Naveed
Department of Pharmaceutical Chemistry
University of Karachi

Prof. Dr. Rabia Bushra
Department of Pharmaceutics
University of Karachi

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Board of Faculty

Prof. Dr. Huma Shareef
Department of Pharmacognosy,
University of Karachi

Dr. Farya Zafar
Associate Professor
Department of Pharmceutics
University of Karachi

Dr. Azra Riaz
Chairperson and Associate Professor
Department of Pharmacology
University of Karachi

Dr. Maryam Ahmed
Associate Professor
Department of Pharmacognosy
University of Karachi

Ms. Farah Mazhar
Assistant Professor
Department of Pharmacognosy
University of Karachi

Dr. Sadia Ghousia Baig
Assistant Professor
Department of Pharmacology
University of Karachi

Ms. Rehana Saeed
Assistant Professor
Department of Pharmaceutics
University of Karachi

Dr. Shazia Haider
Assistant Professor
Department of Pharmaceutical Chemistry
University of Karachi

Dr. Tazeen Hussain
Lecturer
Department of Pharmaceutics
University of Karachi

Dr. Adnan Iqbal
Lecturer
Department of Pharmacology
University of Karachi.

Pharm. D. Program

Student Facilities

1. Foreign Students

Faculty of Pharmacy and Pharmaceutical Sciences admits 20 foreign students to Pharm. D. degree course every year. These admissions are not given directly but only after being duly processed by the concerned Embassies and the Ministry of Economic Affairs in Islamabad.

2. Co-Curricular Activities

a. Annual Tour

Students of Pharm. D. final year tour the country as a part of their training to get acquainted with the various pharmaceutical industries as well as various Pharmacy Institutions (Public Sector) of the country along with sight seeing of our beautiful Pakistan, while the junior students visit the local industries.

b. Pharmacy Students Clubs

Karachi University Pharmacy Students Club (KUPSC) came into being in 2013, exclusively for pharmacy students. Each Club has a number of enrolled students for participating and organizing different events related to sports, literature, drama, science, and leisure activities. KUPSC is looking after these areas under the supervision of faculty members as their patrons.

Chief Patron
Prof. Dr. Muhammad Harris Shoaib

Science Club	Literary Club	Sports Club	Leisure Club
Dr. Sana Sarfaraz (Patron)	**Dr. Tazeen Hussain** (Patron)	**Dr. Shadab Ahmed** (Patron)	**Dr. Shazia Haider** (Patron)
Dr. Safila Naveed (Co-Patron)	**Dr. Sabahat Jabeen** (Co-Patron)	**Dr. Azra Riaz** (Co-Patron)	**Dr. Urooj Nazim** (Co-Patron)
Dr. Kamran Ahmed (Co-Patron)	**Dr. Shadab Ahmed** (Co-Patron)	**Dr. Kamran Ahmed** (Co-Patron)	**Dr. Adnan Iqbal** (Co-Patron)
Dr. Asia Naz (Co-Patron)			

c. Committees: Faculty of Pharmacy

In order to run the faculty smoothly and efficiently in a healthy environment and to enhance the overall quality of the faculty, different committees have been established. These committees are comprised of energetic faculty members, who along with student(s) fulfill the tasks assigned to them.

Seminar Organizing Committee	**Dr. Tazeen Hussain** (Patron), **Dr. Saira Saeed** (Member).
Seminar Library Committee	**Prof. Dr. Nousheen Mushtaq** (Convener), **Ms. Farah Mazhar** (Member), **Dr. Kamran Ahmed** (Member), **Dr. Farrukh Rafiq** (Member), **Dr. Rubina Siddiqui** (Member), **Dr. Azra Riaz** (Member).
Garden Committee	**Ms. Farah Mazhar** (Convener), **Dr. Nuzhat Sultana** (Member), **Dr. Safia Abidi** (Member).
Pharmacy Community Services Committee	**Dr. Urooj Nazim** (Patron), **Dr. Sabahat Jabeen** (Co-Patron), **Dr. Sana Sarfaraz** (Member), **Dr. Adnan Iqbal** (Member).
Scholarship Committee	**Prof. Dr. Nousheen Mushtaq** (Convener), **Prof. Dr. Mohtasheem Ul Hassan** (Member), **Dr. Farya Zafar** (Member), **Dr. Rubina Siddiqui** (Member).
Karachi University Annual Pharma Career Fair (KUAPC) Organizing Committee	**Dr. Farrukh Rafiq** (Convener), **Dr. Sana Sarfaraz** (Coordinator), **Dr. Shadab Ahmed** (Coordinator), **Dr. Kamran Ahmed** (Coordinator).
Catalogue Committee	**Prof. Dr. Nousheen Mushtaq** (Convener), **Ms. Farah Mazhar** (Member), **Prof. Dr. Iyad Naeem Muhammad** (Member), **Dr. Sadia Ghousia Baig** (Member), **Dr. Farya Zafar** (Member).

d. Faculty of Pharmacy Students Advisors

In order to deal with the day today problems of the students and to maintain discipline in the faculty, highly skilled and energetic faculty members have been appointed as student advisors. They also facilitate and collaborate with the clubs and committees in organizing different programs.

List of Student Advisors

Dr. Shadab Ahmed
Dr. Sana Sarfaraz
Dr. Farrukh Rafiq
Dr. Kamran Ahmed
Dr. Sadaf Farooqi
Dr. Safia Abidi
Dr. Urooj Nazim

3. Incentives and Assistance

a. President's Award
Ministry of Health, Government of Pakistan gives this medal to the student who tops in overall performance during the 5 years Pharm. D. courses.

b. Research Fellowships
University of Karachi, the Higher Education Commission and Pakistan Science Foundation grant fellowships for talented students enrolled for M. Pharm., M.Phil. and Ph.D. programs.

c. Scholarships and Fee Remissions
Needy and deserving undergraduate students are given full-fee/half-fee remissions through some of the recently initiated scholarships.

d. Duty Loan
These interest-free loans are granted by Banker's Equity of Pakistan to outstanding and deserving students. Moreover, Pakistan Fauji Foundation and other social and cultural organizations give financial assistance to needy students.

4. Gold Medals

- Hakimsons Chemical Industries Gold Medal is awarded to a student, who performs best in the 5 years Pharm. D. degree courses.
- Prof. S.M.S. Zoha Gold Medal is awarded to a student who secured best CGPR in Pharmacy at the B.Pharm. / Pharm. D. examinations.
- Fauzia Rashid Gold Medal is received by a student who stands first in the Pharm. D. examinations.
- Amna Feroz Gold Medal goes to a student who stands first at the B.Pharm. / Pharm. D. examinations.
- Al-Haj Ikram Siddiqui Gold Medal goes to the most outstanding M.Pharm. student of the faculty.

Publications

1. Pakistan Journal of Pharmaceutical Sciences

The Pakistan Journal of Pharmaceutical Sciences (PJPS) is the offcial bi-monthly publication of the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. It publishes high quality, peer reviewed articles on related subjects. PJPS has Impact Factor 0.692 and its contents are indexed and abstracted in the Chemical Abstracts, MEDLINE/PubMed, Index Copernicus, Index Medicus, CAB Abstracts, ISI, Global Health, Pubget, SADCCT, NLM LocatorPlus, GDPBM, IMEMR, SCImago, EVISA, Serial Cited, EBSCO, PDB, IndexPharmacus, AsiaNet, ResearchGate and PakMediNet.

2. Pakistan Journal of Pharmacology

Recently the rights and authority of the Pakistan Journal of Pharmacology has been delegated to the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. Every year two issues of the journal are published under the supervision of the Dean.

3. Farmacia

Faculty of Pharmacy and Pharmaceutical Sciences also publishes a bi-lingual magazine "Farmacia" annually, which comprises articles on various topics on pharmacy as well as covers various activities and events involving students, held in the faculty of Pharmacy and Pharmaceutical Sciences. Farmacia also publishes interviews of the faculty members. This magazine is published on regular basis, and students of faculty of the Pharmacy and Pharmaceutical Sciences participate in it with their articles in both Urdu and English languages.

4. Graduate Directory

A graduate directory of the final year students is prepared and published every year. This directory helps the students to seek jobs of their interest as well as pursue their careers as per their choice and ambition.

Admission & Examinations Under-Graduate Studies

1. Pharm. D. Admissions

Admissions in Karachi University are given according to merit. There is no discretionary quota for admissions. However, certain seats are reserved for disabled persons and children of university teachers and employees. For these seats also, admissions are given on the criterion of merit.

Admissions on Merit Seats
Prior to granting admission the students are required to appear in a qualifying test in which it is mandatory to score 50% marks. Since the number of applicants is much higher than the number of available seats, under the University rules the applicants have been divided into three categories i.e. K, S, and P.

i. Category "K". Preference shall be given to those applicants, who have passed Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) or equivalent examinations from an educational institution situated in Karachi and also recognized by the University.
Whereas, for admission in Master's degree program, in addition to the SSC and HSC, preference shall be given to those applicants who have also obtained graduation degree from an academic institution affiliated to the University of Karachi. Five percent (5%) seats have been reserved for applicants who have done their graduation from a non-public sector, degree awarding institute situated in Karachi and recognized by the University of Karachi.

ii. Category "S" comprises those applicants who have passed their pre-requisite examinations from a recognized educational institution in the Province of Sindh (excluding Karachi).

iii. Category "P" comprises those applicants who have passed their pre-requisite examinations from a recognized educational institution outside the Province of Sindh.

Preference in admissions is given to "K" category candidates. In case seats are left, "S" category candidates are considered. If seats are still available then consideration is given to "P" category candidates.

Change of Category
Candidates who fulfill the following conditions can apply for change of category from S or P to K.

i. Those students whose father or mother is domiciled in Karachi, but who have passed the requisite examination from any registered National or International Institution outside Karachi or from any Pakistan Board or University which conducts examinations in foreign countries and they have passed their examination from abroad, such candidates will have to produce their father's or mother's domicile certificate with their applications.

ii. Students whose parents are employees of the Federal or Sindh Governments, or of autonomous or semi-autonomous bodies of Government Corporations, or of the Armed Forces, who have been posted in or transferred to Karachi within the last two years. Such applicants will have to produce the appointment letter or transfer letter of their father/mother together with their applications.

iii. 3% seats in each department will be allocated for those candidates who have passed their pre-requisite examination from a recognized educational institution located outside Karachi but they have their initial education including Matric/Intermediate from Karachi. Such candidates should have Karachi P.R.C. and their parents should have domicile and N.I.C. of Karachi. Candidates below the age of 18 years are required to submit photocopy of 'B' Form.

Application for Change of Category
All such applicants who fulfill the criteria for change to category K, should attach with their forms an application on plain paper for change of category together with their father's/mother's domicile certificate, NIC and appointment/transfer letter. At the time of admission, they will have to produce the original and photo copies of all documents.

Admissions on Reserved Seats
Some seats have been reserved for dependents of Karachi University employees, sports and disabled persons. Candidates for admission to these seats should ensure that they meet the criteria of eligibility for the University as well as the concerned department. The candidates will have to submit a separate form for reserved seats.

The merit list for these seats is prepared for different departments on the basis or recommendations by the concerned Committee. It may be mentioned that certain departments have limited the number of students to be admitted on reserved seats because of the unusually large number of applicants. Admission forms for these seats can be obtained from the office of the Deputy Registrar (Academic).

Conditions for Eligibility
The conditions for eligibility for all candidates, whether for merit seats or for reserved/donor's seats are as under:

For admission in the Faculty of Pharmacy and Pharmaceutical Sciences, the candidate should have obtained minimum of 60 per cent marks (B-Grade) in Intermediate/H.S.C. (Biology Group) and qualifying

entry test for Pharm D program (by University of Karachi. Candidates desirous of taking admission on the basis of degrees/certificates other than University of Karachi should get the equivalence of their degrees/certificates determined by the University Equivalence Committee well before the scheduled date of admissions. Candidates holding 'O' Level, 'A' Level or other foreign degrees/certificates should get the equivalence of their grades and marks determined before the scheduled date.

2. Examinations

System of Examination and Grading

I. Terminal Examination

The examination held at the end of semester after the completion of a course is known as Terminal Examination. It will carry 100 marks. This examination's passing head, i.e., a student must obtain a minimum of 50 marks for each course in this examination.

II. Grading System

Grades given to a student in each course is of two types:

i. Numerical Grade (NG) Assessment of performance on the basis of marks out of 100 fixed for a course of 3 or 2 credit hours unit is NG.

ii. Alphabetical Grade (AG) Equivalent of numerical grades in terms of alphabets shall be termed as alphabetical grades. (Each letter carries a value in terms of numerical points).

iii. Grading

Marks (NG)	Grade (AG)	Grade Point
90 & above	A+	4.0
85-89	A	4.0
80-84	A-	3.8
75-79	B+	3.4
71-74	B	3.0
68-70	B-	2.8
64-67	C+	2.4
61-63	C	2.0
57-60	C-	1.8
53-56	D+	1.4
50-52	D	1.0
Below 50	Fails	0.0

iv. Incomplete Grade
For incomplete courses no point shall be given.

v. Grade Point Ratio (GPR)
Points obtained in each course shall be multiplied by the number of credit hours specified for that course, and then a grade point ratio (GPR) shall be calculated.

Formula:

Grade points in a Course= Credit hours of the course X Grade point equivalent to the score given in the grade point table

vi. Cumulative Grade Point Ratio (CGPR)
This is obtained by adding all the Grade Points of the courses during 5 years study period and dividing the total by the total number of credit hours.

$$\text{CGPR} = \frac{\text{Total Grade Points in all the courses}}{\text{Total number of Cr. Hrs.}}$$

3. Requirement for the Award of Pharm. D. Degree

A student must have passed all prescribed courses (Total 97 courses) and obtain a minimum CGPR 2.45. Any student who fails to acquire a minimum CGPR of 2.45 may be awarded a condoned degree with a CGPR of 2.0.

Note: The condoned degree holder from the University of Karachi or any other university will be considered ineligible for admission in any of the post-graduate programs offered by the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi.

4. Rules Concerning the Promotion and Repetition of Course*

a. A student would be promoted to next higher class upon clearing 80% of the courses (11 out of 14). In case of any misinterpretation and discrepancy, Deans' Committee would be the final authority in deciding any representation.
b. If a student is unable to complete the attendance requirement in any course, he/she shall be required to attend the entire course whenever it is offered again. He /She will become eligible for taking the examination in the particular course only after he/she has completed its attendance requirement. Such a student shall pay a prescribed fee for attending the classes as Casual Student.
c. If a student, after completing the attendance requirement, does not appear or fails in the terminal examination of a course, he/she will be allowed to re-appear not more than twice in the terminal examination when it is offered in the next session after the payment of prescribed examination fee as Repeater Student.
d. A repeater student who fails to clear a course(s) in three regular, available chances will not be eligible to re-appear. He/She may be allowed as a last chance to attend the classes of the course/courses he/she failed to clear. Permission to appear in the examination will be subject to completing attendance requirements.

*(Approved by the Academic Council on 17-3-1999, vide Resolution No.1)

5. Attendance

Attendance in each subject is compulsory for all students and no student shall be eligible to appear at any University examination unless he/she has attended 75 per cent attendance in the course.

i. The attendance of students admitted in the faculty will be counted from the 1st day of semester and not from the date of admission.

ii. Students called for national duty such as participation in Olympics, National Games, Inter-varsities, and going to perform Haj would be given exemption in attendance for the actual period of national duty/Haj. These cases would be decided individually.

iii. If a student is unable to attend classes continuously for 15 days or more without informing the Dean/Chairperson of the Department (in writing) his/her admission will also stand cancelled. In case of illness or other similar situation, application along with a medical certificate from a registered medical practitioner duly verified by the Senior Medical Officer of the University must be submitted within two days after the incident.

iv. Shortage of attendance may be condoned by 5% by the Chairman of the department for bonafide reasons. The Vice Chancellor may condone a further shortage of 10% in cases of special hardships, but no student whose attendance falls below 60% shall be sent up for any University examination.

v. Original attendance register is to be submitted to the Dean/Chairperson for record and future reference.

6. Cancellation of Admission/Readmission

i. If a student admitted to Pharm.D. 1st year class for the first time and fails to attend the class for the first 15 days, his/her admission shall stand cancelled.

ii. If a student absents himself/herself for 15 consecutive days during the semester without any information, his/her admission shall also be cancelled. Re-admission would be granted in the same semester by the Dean if he/she can complete his/her attendance requirement.

iii. If a student is unable to continue his/her studies, his/her admission will be treated as cancelled. He/she may however be re-admitted after the payment of prescribed fee in the same semester where he/she had left. Permission would be granted by the Dean.

iv. He/she may be allowed 3 chances to pass/get promoted in the next higher class if he/she has completed the attendance requirements.

7. Unfair Means

All the cases of unfair means will be forwarded to the Committee appointed for the purpose and the matter will be dealt with in accordance with the rules and regulations of the University.

8. Interpretation of Semester Rules

The decision of the Deans' Committee would be final for the interpretation of semester rules. In case of any appeal, Deans' Committee would dispose it off on its merits.

9. In the Examination Hall

i. No candidate shall be admitted into the examination hall without the prescribed admit card and enrolment card, issued by the university. Candidates are liable to expulsion form the examination Hall for failure to produce the University Admit Card, the Enrolment Card and the University Identity Card.
ii. Do not forget to attach the photocopy of the admit card, which is only the proof of fee-payment.
iii. No one should smoke inside the examination hall.
iv. In case of walk-out, there shall be no re-examination under any circumstances.
v. No materials or electronic devices shall be brought into the room or used at an examination. Unauthorized materials include, but are not limited to: books, class notes, or aid sheets. Unauthorized electronic devices include, but are not limited to: cellular telephones, laptop computers, calculators, MP3 players (such as an iPod), personal digital assistants ("PDA' such as a Blackberry), electronic dictionaries, compact disc players, and mini disc players.

10. Pharm. D Program Structure

The Pharm D program is spread over ten regular semesters and structured as under:

a. Minimum Credit Hours for Pharm D

195 (without specialization)
210 (with specialization*)
* The specialization track is optional and at the discretion of student/Faculty of Pharmacy and Pharmaceutical Sciences

b. Pharm D Courses

All the courses of the Pharm D curriculum (core, interdisciplinary and generalized courses) are distributed among the five major departments of the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. Following are the departments coded as:

Name of the Department	Code
Pharmaceutical Chemistry	PHC
Pharmacognosy	PHG
Pharmacology	PHL
Pharmacy Practice	PHP
Pharmaceutics	PHT

c. Clinical Pharmacy Clerkship

Three credit hours structured, hands-on training period is mandatory where pharmacy students work in real healthcare settings (hospital/community) under the supervision of licensed pharmacists and other healthcare professionals. The clerkship will be conducted by the Department of Pharmacy Practice and will commence form 5th semester.

d. Capstone Project/ Experiential Learning Project (ELP)

A Capstone Project/ Experiential Learning Project (ELP) worth 3 credit hours is a mandatory comprehensive project required to be completed by the Pharm D graduating student, between the

5th semester to the end of the degree. It allows students to apply their pharmacy knowledge to solve real-time problems, demonstrate critical thinking, and show readiness for professional practice. The project will be supervised and graded by the faculty members.

e. Program Duration

The degree enrollment of the Pharm D program is valid for a minimum of 5 years and maximum of 7 years duration. The extension is subject to the University of Karachi's statutory body approval. However, a student unable to complete his/her degree requirement within the validity of his/her enrollment, will have to re-validate/extend his/her enrollment for not more than 2 years by paying a prescribed fee with the permission of the Dean.

f. Semester Duration

The regular semester will span between 16-18 weeks of teaching followed by 1-2 weeks for exams.

g. Course Load per Semester

The regular semester will have a 15-21 credit hours load.

h. Credit Hours

For a 3 credit hours theory course, 3 classes of 1 hour each or 2 classes of 1.5 hours each or 1 class of 3 hours per week will be held. For a 2 credit hours theory course, 2 classes of 1 hour each or 1 class of 2 hours per week will be held. For lab/field work, 1 credit hour work will be equivalent to 3 contact hours per week.

Course Schedule
Pharm. D. Program

First Professional

S. No.	Course NO.	Course Title - 1st Semester	Cr. Hrs.	Category
1	*PHT-301	Physical Pharmacy - I	3	Core
2	PHT-303	Physical Pharmacy (Lab) - I	1	Core
3	**PHC-305	Organic Chemistry - I	3	Core
4	PHC-307	Organic Chemistry (Lab) - I	1	Core
5	PHC-309	Biochemistry - I	2	Core
6	PHC-311	Biochemistry (Lab) - I	1	Core
7	***PHL-313	Physiology - I	3	Allied/Inter.
8	PHL-315	Physiology (Lab) - I	1	Allied/Inter.
9	****PHG-317	Functional English	3	General Edu.
			Total Cr. Hrs. **18**	

S. No.	Course NO.	Course Title - 2nd Semester	Cr. Hrs.	Category
1	PHT-302	Physical Pharmacy - II	3	Core
2	PHT-304	Physical Pharmacy (Lab) - II	1	Core
3	PHC-306	Organic Chemistry - II	3	Core
4	PHC-308	Organic Chemistry (Lab) - II	1	Core
5	PHC-310	Biochemistry - II	2	Core
6	PHC-312	Biochemistry (Lab) - II	1	Core
7	PHL-314	Anatomy and Histology	2	Allied/Inter.
8	PHL-316	Anatomy and Histology (Lab)	1	Allied/Inter.
9	PHL-318	Physiology - II	3	Allied/Inter.
10	PHL-320	Physiology (Lab) - II	1	Allied/Inter.
11	PHL-322	Islamic Studies	2	General Edu.
			Total Cr. Hrs. **20**	

* **PHT Pharmaceutics**
** **PHC Pharmaceutical Chemistry**
*** **PHL Pharmacology**
**** **PHG Pharmacognosy**

Course Schedule
Pharm. D. Program

Second Professional

S. No.	Course NO.	Course Title - 1st Semester	Cr. Hrs.	Category
1	PHT-401	Drug Delivery and Formulation Science - I	3	Core
2	PHT-403	Drug Delivery and Formulation Science (Lab) - I	1	Core
3	PHL-405	Pharmacology and Therapeutics - I	3	Core
4	PHL-407	Pharmacology and Therapeutics (Lab) - I	1	Core
5	PHG-409	Pharmacognosy (Basic) - I	3	Core
6	PHG-411	Pharmacognosy (Basic) (Lab) - I	1	Core
7	PHL-413	Pathology	2	Allied/Inter.
8	PHL-415	Pathology (Lab)	1	Allied/Inter.
9	PHT-417	Basic Pharmaceutical Microbiology	2	General Edu.
10	PHT-419	Basic Pharmaceutical Microbiology (Lab)	1	General Edu.
			Total Cr. Hrs. **18**	

S. No.	Course NO.	Course Title - 2nd Semester	Cr. Hrs.	Category
1	PHT-402	Drug Delivery and Formulation Science - II	3	Core
2	PHT-404	Drug Delivery and Formulation Science (Lab) - II	1	Core
3	PHT-406	Applied Pharmaceutical Microbiology and Immunology	3	Core
4	PHT-408	Applied Pharmaceutical Microbiology and Immunology (Lab)	1	Core
5	PHL-410	Pharmacology and Therapeutics - II	3	Core
6	PHL-412	Pharmacology and Therapeutics (Lab) - II	1	Core
7	PHG-414	Pharmacognosy Basic - II	3	Core
8	PHG-416	Pharmacognosy Basic (Lab) - II	1	Core
9	PHL-418	Fehm-e-Quran - I	1	General Edu.
10	PHG-420	Pakistan Studies	2	General Edu.
			Total Cr. Hrs. **19**	

Course Schedule
Pharm. D. Program

Third Professional

S. No.	Course NO.	Course Title - 1st Semester	Cr. Hrs.	Category
1	PHC-501	Pharmaceutical Analysis - I	3	Core
2	PHC-503	Pharmaceutical Analysis (Lab) - I	1	Core
3	PHL-505	Pharmacology and Therapeutics - III	3	Core
4	PHL-507	Pharmacology and Therapeutics (Lab) - III	1	Core
5	PHG-509	Pharmacognosy (Applied)	3	Core
6	PHG-511	Pharmacognosy (Applied) (Lab)	1	Core
7	*****PHP-513	Social and Administrative Pharmacy - I	2	Core
8	PHC-515	Quantitative Reasoning - I (Maths)	3	General Edu.
9	PHG-517	Ideology and Constitution of Pakistan	2	General Edu.
10	PHL -519	Fehm-e-Quran - II	1	General Edu.
			Total Cr. Hrs. **20**	

S. No.	Course NO.	Course Title - 2nd Semester	Cr. Hrs.	Category
1	PHC-502	Pharmaceutical Analysis - II	3	Core
2	PHC-504	Pharmaceutical Analysis (Lab) - II	1	Core
3	PHL-506	Pharmacology and Therapeutics - IV	3	Core
4	PHL-508	Pharmacology and Therapeutics (Lab) - IV	1	Core
5	PHG-510	Pharmacognosy (Advanced)	3	Core
6	PHG-512	Pharmacognosy (Advanced) (Lab)	1	Core
7	PHP-514	Social and Administrative Pharmacy - II	2	Core
8	PHT-516	Application of ICT (Information and Communication Technology)	2	General Edu.
9	PHT-518	Application of ICT (Lab)	1	General Edu.
10	PHC-520	Quantitative Reasoning - II (Biostats)	3	General Edu.
			Total Cr. Hrs. **20**	

***** **PHP** **Pharmacy Practice**

Course Schedule
Pharm. D. Program

Fourth Professional

S. No.	Course NO.	Course Title - 1st Semester	Cr. Hrs.	Category
1	PHT-601	Industrial Pharmacy - I	3	Core
2	PHT-603	Industrial Pharmacy (Lab) - I	1	Core
3	PHT-605	Biopharmaceutics and Pharmacokinetics - I	3	Core
4	PHT-607	Biopharmaceutics and Pharmacokinetics (Lab) - I	1	Core
5	PHP-609	Clinical Pharmacy - I	3	Core
6	PHP-611	Clinical Pharmacy (Lab) - I	1	Core
7	PHT-613	Expository Writing	3	General Edu.
8	PHT-615	Entrepreneurship	2	General Edu.
9	PHT-617	Pharmaceutical Marketing and Management	2	General Edu.
			Total Cr. Hrs. **19**	

S. No.	Course NO.	Course Title - 2nd Semester	Cr. Hrs.	Category
1	PHT-602	Industrial Pharmacy - II	3	Core
2	PHT-604	Industrial Pharmacy (Lab) - II	1	Core
3	PHT-606	Biopharmaceutics and Pharmacokinetics - II	3	Core
4	PHT-608	Biopharmaceutics and Pharmacokinetics (Lab) - II	1	Core
5	PHC-610	Pharmaceutical Quality Control	2	Core
6	PHC-612	Pharmaceutical Quality Control (Lab)	1	Core
7	PHP-614	Clinical Pharmacy - II	3	Core
8	PHP-616	Clinical Pharmacy - II (Lab)	1	Core
9	PHP-618	Civics and Community Engagement	1	General Edu.
10	PHP-620	Civics and Community Engagement (Lab)	1	General Edu.
11	PHP-622	*Pharmacy Practice Experience, PPE (Clinical Clerkship)	3	Core
			Total Cr. Hrs. **20**	

Course Schedule
Pharm. D. Program

Fifth Professional

S. No.	Course NO.	Course Title - 1st Semester	Cr. Hrs.	Category
1	PHT-701	Pharmaceutical Technology - I	3	Core
2	PHT-703	Pharmaceutical Technology (Lab) - I	1	Core
3	PHT-705	Pharmaceutical Quality Management Systems	3	Core
4	PHC-707	Medicinal Chemistry - I	3	Core
5	PHC-709	Medicinal Chemistry (Lab) - I	1	Core
6	PHL-711	Clinical Pharmacology	2	Core
7	PHL-713	Clinical Pharmacology (Lab)	1	Core
8	PHP-715	Advanced Clinical Pharmacy -I	3	Core
9	PHP-717	Advanced Clinical Pharmacy - I (Lab)	1	Core
10	PHP-719	Pharmaceutical Regulatory Science - I	3	Core
		Total Cr. Hrs. **21**		

S. No.	Course NO.	Course Title - 2nd Semester	Cr. Hrs.	Category
1	PHT-702	Pharmaceutical Technology - II	3	Core
2	PHT-704	Pharmaceutical Technology (Lab) - II	1	Core
3	PHC-706	Medicinal Chemistry - II	3	Core
4	PHC-708	Medicinal Chemistry (Lab) - II	1	Core
5	PHP-710	Advanced Clinical Pharmacy - II	3	Core
6	PHP-712	Advanced Clinical Pharmacy - II (Lab)	1	Core
7	PHP-714	Pharmaceutical Regulatory Science - II	3	Core
8	PHL -716	Bioethics	2	General Edu.
		Total Cr. Hrs. **17**		

*Capstone Project/ Experiential Learning Project (ELP), supervised and graded by the faculty members	**3 credit hours**

Total Courses = 97 **Total Credit Hours = 195**

***The Capstone project and Clinical clerkship is applicable to third professional onward.**

Course Schedule
Pharm. D. (Deficiency) Program

First Semester

Course NO.	Course Title	Cr. Hrs.
PHC - 303 (D)	Pharmaceutical Chemistry (Organic and Inorganic)	2
PHC - 505 (D)	Theoretical Basis of Quality Control	2
PHT - 513 (D)	Computer Application in Pharmacy	2
PHT - 613 (D)	Pharmaceutical Technology	3
PHC - 707 (D)	Pharmaceutical Analysis	2
PHL - 711 (D)	Clinical Pharmacology	2
PHG - 713 (D)	Clinical Pharmacognosy	2
PHL - 715 (D)	Anatomy	2
PHL - 721 (D)	Pathology (Theory & Practical)	3
Total Courses 9		**Cr. Hrs. 20**

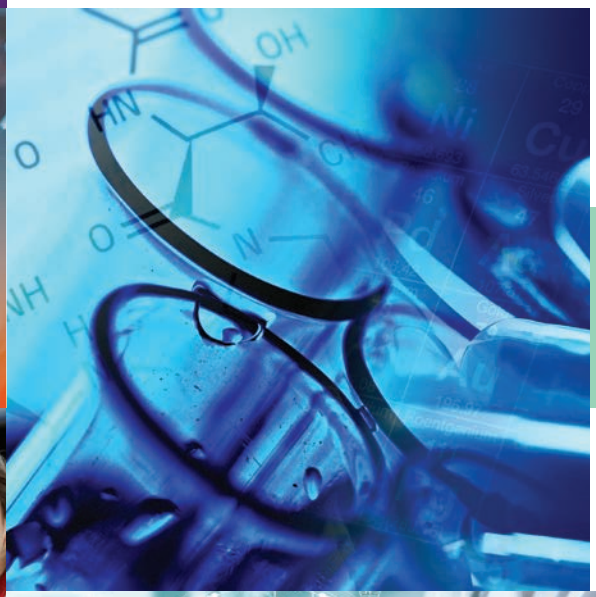
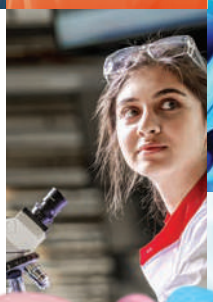
Second Semester

Course NO.	Course Title	Cr. Hrs.
PHC- 406 (D)	Physical Chemistry (Lab.)	2
PHG- 514 (D)	Natural Toxicants	2
PHT- 606 (D)	Clinical Pharmacokinetics	3
PHT- 614 (D)	Pharmaceutical Technology (Practical)	3
PHT- 702 (D)	Clinical Pharmacy	3
PHT- 708 (D)	Pharmaceutical Quality Control and Assurance	2
PHC- 710 (D)	Medicinal Chemistry	3
PHL - 712 (D)	Toxicology	2
PHL - 718 (D)	Physiology, Histology and Biochemistry (Practical)	3
Total Courses 9		**Cr. Hrs. 23**

Total Courses = 18 **Total Credit Hours = 43**

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Department of
Pharmaceutics

Message

The Chairman, Department of Pharmaceutics

Pharmaceutics encompasses many subject areas that are involved in transforming a drug into a medicine. It starts from discovery and purification to evaluating therapeutic benefits and ensuring minimal toxicity. In simple terms, Pharmaceutics is the science of dosage form design.

The field continues to advance beyond conventional dosage forms such as tablets, capsules, and injectables toward modern drug delivery systems such as nanotechnology and targeted delivery. Approaches like Quality by Design (QbD) now guide pharmaceutical development, helping improve product quality and ensure a consistent supply of medicines.

The Department of Pharmaceutics at the University of Karachi is dedicated to preparing future pharmacists who will play leading roles in the pharmaceutical industry, hospitals, community pharmacies, academia, and research. The department offers revised curriculum for Doctor of Pharmacy (Pharm.D.) aligned with HEC Undergraduate Education Policy and the standards of Pharmacy Council of Pakistan. The curriculum is delivered in a student-centered environment that supports a higher level of learning. With 13 committed faculty members, most holding doctoral degrees and actively involved in teaching and research, the department provides well equipped classrooms and laboratories that offer meaningful practical experience. Students in the Faculty of Pharmacy benefit from instruction by respected experts who prepare them to contribute effectively to the pharmaceutical profession.

I congratulate the students for securing admission to this prestigious institution and hope that they will bring much pride to the faculty.

Prof. Dr. Syed Muhammad Farid Hasan

Chairman

Department of Pharmaceutics

The Department of Pharmaceutics is a core academic and research unit within the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. It deals with the scientific and technological aspects of designing safe, effective, and high-quality drug delivery systems. The department plays a vital role in educating students the fundamentals of drug formulation, drug delivery, processes, and regulatory system and facilitating hands-on training through research laboratories and industrial exposure. Pharmaceutics Department combines principles of physical pharmacy, pharmaceutical microbiology, industrial pharmacy, biopharmaceutics, pharmacokinetics, pharmaceutical technology, quality assurance, marketing and regulatory sciences to ensure not only manufacturability and stability but also patient compliance with safety and efficacy.

Moreover, the Department of Pharmaceutics imparts research on innovative drug delivery systems, nanotechnology-based formulations, controlled-release dosage forms, transdermal formulations, and many other novel drug delivery systems. Through its academic programs, laboratories, and research initiatives, the department prepares students to work exceptionally in pharmaceutical industries, regulatory bodies, hospitals, and research institutions.

Department of Pharmaceutics, Faculty of Pharmacy & Pharmaceutical Sciences, University of Karachi, comprises of 13 academic and 13 non-academic staff, including five Professors, one Associate Professor, two Assistant Professors, three Assistant Professors (T) and two lecturers. The department is actively involved in pharmaceutical research that covers all aspects of pharmaceutical sciences offering M.Pharm., M.Phil., and Ph.D. degree programs. To date, the department has produced over 188 M.Pharm, 110 M.Phil. and nearly 100 Ph.D. and M.Phil./ Ph.D. graduates so far in different disciplines of pharmaceutics.

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Department of **Pharmaceutics**

Vision

The Department of Pharmaceutics envisions a high quality, innovative, cost-effective and equitable pharmaceutical and healthcare industry by becoming a dependable source of 'high-quality skilled professionals' and 'research-based solutions' to various challenges in the industry.

Mission

Pharmacists are essential partners to the health care providing team and play a distinguished role in providing healthier and better lives.

In contrast to different Pharm D programs offered by various schools of pharmacy, the Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, is contributing in the human resource across the globe since 1974. The department has designed the courses of Pharmaceutics to bring excellence in pharmacy education and betterment in community service. The courses are specially designed to fulfill the requirements of pharmaceutical manufacturing sector and to provide optimal patient care. The objective is to produce a proficient pharmacist in medication management with distinct leadership skills and ability to demonstrate and effectively communicate with other related professionals. The graduate must have sufficient knowledge to meet the everyday rising demand of pharmaceutical manufacturers especially in the field of product development. The Pharm D program is accredited by the Pakistan Pharmacy Council, making pharmacy graduates eligible for regional and international licensure.

Dr. Muhammad Harris Shoaib

Professor

Qualification
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Year of Association
2000

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Dr Harris is the Dean, Faculty of Pharmacy and Pharmaceutical Science. He is also the Professor and Ex Chairman of the Department of Pharmaceutics, Faculty of Pharmaceutical Sciences, University of Karachi. He has done his BPharm. (1994), M.Phil. (1998) and Ph.D. (2004) from the University of Karachi. More than 25 years of teaching and research experience in various academic positions. Supervised more than 35 Ph.D., 40 M.Phil. and 20 M.Pharm. students. Published around 200 research publications in impact factor journals with an overall citation of 2600 and an impact factor of 230 (h-index 23 and i10 index 40). Invited reviewer for many international journals. Member Board of Studies and Board of Faculty not only in this University but in various other Universities of Karachi. Awarded Productive Scientist of Pakistan from Pakistan Council for Science and Technology. Already won two NRPU projects and one SRSP project. He is also the elected member of the Syndicate, the Academic Council, and the Senate. He was also the member of the member Pharmacy Council of Pakistan from 2006-2012.His area of expertise is in Pharmaceutics, Drug Delivery System, Biopharmaceutics and Pharmacokinetics, Pharmaceutical Microbiology, and Pharmacy Practice.

Dr.Syed Muhammad Farid Hasan

Chairman and Professor

Qualification
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2006

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Dr. Syed Muhammad Farid Hasan has received B.Pharm., M.Phil. and Ph.D. degrees from the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. He has a rich experience of more than two decades of serving in pharmaceutical industries and academia (administration, teaching and research). He also served in College of Pharmacy, Almaarefa University, Riyadh, Kingdom of Saudi Arabia. His areas of interest are; Formulation and Product Development, Novel drug delivery system, Solubility enhancement of poorly soluble drugs, Biopharmaceutics and Pharmacokinetics, Bioequivalence etc.

Dr. Rabia Ismail Yousuf

Professor

Qualification
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Dr. Rabia Ismail Yousuf received her BPharm degree in year 2001, M.Phil. (Pharmaceutics) in 2005, and received her Ph.D. degree (Pharmaceutics) in year 2009 from University of Karachi. She joined Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in year 2006. She is currently serving as a professor. She is a member of board of studies and board of faculty of different colleges of Pharmacy. She has won multiple research grants from the Higher Education Commission (HEC) and Sindh Higher Education Commission (SHEC). There are around 2000 citations of her 130 research article. She bears h-index 19 and i10-index 43. She has 15 M.Phil. and Ph.D. students on her credit so far. She served also as faculty student advisor from 2011-2017.

Her research areas include designing drug delivery system (Hydrodynamically controlled gastroretentive system, osmotically controlled system, transdermal system, Oro-disintegrating/dissolving system, etc.), immediate release and controlled release formulations design (tablets, transdermal patches, microneedles, pellets, mini-tablets etc.) and optimization by Quality by Design (QbD), in silico application as predictive tool for formulation performance and physiologically based pharmacokinetic (PBPK) modelling and real-time Bioavailability and Bioequivalence (BA/BE) studies.

Dr. Iyad Naeem Muhammad

Professor

Qualification
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Dr. Iyad Naeem joined the Faculty of Pharmacy in 2006, after over five years' experience as a hospital pharmacist. He holds a Ph.D. in Pharmaceutics from University of Karachi, specializing in formulation development, optimization, and population pharmacokinetics, along with an M.Phil. focusing on antimicrobial resistance and nosocomial infections. Currently he is Professor, teaching undergraduate and postgraduate courses in Dosage Forms, Pharmaceutical Quality Control, Forensic Pharmacy, and Hospital Pharmacy. His research interests include Pharmaceutical Microbiology, Formulation Development, and Pharmacy Practice, and he has supervised numerous graduate students in related fields.

Dr. Rabia Bushra

Professor

Dr. Rabia Bushra has recently joined the Faculty of Pharmacy and Pharmaceutical Sciences as Professor. She is an experienced academician with a strong research background in Pharmaceutics, committed to bridging theory and practice through innovative teaching and translational research. She has a keen interest in formulation sciences, biowaiver studies, Stability testing, In vitro drug release kinetics and Pharmacokinetics. She is an active member of academic boards and faculties across various pharmacy institutions, contributing to policy development, curriculum design and educational excellence.

Qualification
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Year of Association
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Dr. Farya Zafar

Associate Professor

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Dr Farya Zafar received her B.Pharm. degree from Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 2001, an M.Phil. degree and Ph.D. degree in Pharmaceutics from Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 2006 and 2013 respectively. Her area of interest is in Formulation Development, Pharmacokinetics and Bio-Pharmaceutics. Her research expertise is in Pharmaceutical Technology, Formulation designing and development of drug delivery system.

Dr. Sabahat Jabeen

Assistant Professor

Dr. Sabahat Jabeen is currently serving as an Assistant Professor in the Department of Pharmaceutics. She received her B.Pharm. degree from the University of Karachi in 1991. In 2003, she completed her M.Phil. followed by Ph.D. in Pharmaceutics in 2018 from the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. Her academic and research interests are primarily centered around Physical Pharmacy, as well as the formulation development and optimization of pharmaceutical products.

Qualification
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Ms. Rehana Saeed

Assistant Professor

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Ms. Rehana Saeed received her B.Pharm. degree from Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 1993, an M.Phil. degree in Pharmaceutics from Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 2001. Her area of interest is in Pharmaceutical Microbiology, Pharmacokinetics, Formulation Development, Hospital Pharmacy and Clinical Pharmacy.

Dr. Faaiza Qazi

Assistant Professor (T)

Qualification
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(University of Karachi)

Year of Association
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Faaiza Qazi received her Pharmacy degree with gold medals as secured first position from the University of Karachi, a M.Phil. degree in Pharmaceutics from the University of Karachi, and a Ph.D. in development and optimization of extended-release pellets and their pharmacokinetics from University of Karachi. Her research and teaching focus on the designing and optimization of novel drug delivery systems and determining their pharmacokinetics. She is the principal investigator for the controlled/sustained release formulations development and optimization team in the Department of Pharmaceutics at the University of Karachi, where her laboratory focuses on designing and optimizing a variety of novel drug delivery systems like pellets, nanoparticles, gummies, minitablets, osmotic pump tablets etc.

Dr. Farrukh Rafiq Ahmed

Assistant Professor (T)

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Year of Association
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Dr. Farrukh Rafiq Ahmed is a pharmaceutical scientist and educator with extensive expertise in formulation science and pharmacokinetics. Currently serving as an Assistant Professor in the Department of Pharmaceutics at the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, Dr. Ahmed has more than one and a half decades of experience in research, teaching, and mentoring.

His research focuses on innovative drug delivery systems, including amorphous solid dispersions, intranasal powder-based formulations, and transdermal drug delivery. He has contributed significantly to pharmaceutical science through over 40 research publications in reputable SCI-indexed journals, three book chapters, and various high-impact research projects.

He is a seasoned trainer in Quality by Design (QbD) approach for formulation development, a sitting member of the Pakistan Pharmacists Association-Sindh and HEC national curriculum committee, and an organizer of 'Career Summits and Fairs' since 2019, nurturing hundreds of young professionals for various specializations in pharma sectors. Moreover, Dr Ahmed is also serving as an associate editor of the international journal 'Biointegration' beside serving on the editorial advisory board of the 'Pakistan Journal of Pharmaceutical Sciences'.

Dr. Ahmed's work exemplifies a commitment to advancing pharmaceutical education and research, ensuring his contributions resonate in both academic and professional domains.

Dr. Kamran Ahmed

Assistant Professor (T)

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Dr. Kamran Ahmed received his Ph.D. and M.Phil. degree from Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. He received his B.Pharm. degree from Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi with 1st class 3rd position. His teaching focus on Pharmaceutics subjects including design of dosage forms, Physical Pharmacy, Industrial Pharmacy, Dispensing Pharmacy. He is the principal Investigator for the osmotic drug delivery system design team and was the among the initial investigators in Pakistan who researched on oral osmotic drug delivery systems and published manuscripts in worldwide reputable journals. Several postgraduate (M.Phil. & Ph.D.) students are working under supervision. His Area of research expertise is Design and Evaluation of Controlled Drug Delivery Systems like Osmotic pumps, Bilayer tablets, Matrix tablets etc. He is currently also Faculty student advisor.

Dr. Sadaf Farooqi

Lecturer

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Sadaf Farooqi B.Pharm., M.Phil., Ph. D, RPh is a lecturer in the Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. She earned her Bachelor of Pharmacy (B.Pharm.) degree from the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, in 2001. She completed her M.Phil. in Pharmaceutics in 2012 from the same institution and was awarded her Ph.D. in Pharmaceutics in 2024 from the Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi.

Her research interests encompass novel drug delivery systems, in silico modeling for formulation development, Pharmaceutical Microbiology and innovative strategies to help advance the quality of Pharmacy education and public health.

Dr. Tazeen Husain

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Dr Tazeen Husain received her Pharm D degree from the University of Karachi, where she also completed her M.Phil. and Ph.D. in the Department of Pharmaceutics, Faculty of Pharmacy and Pharmaceutical Sciences. She specializes in both conventional and novel formulation development. Beyond pharmaceutical formulation development and characterization, her areas of interest include social pharmacy, pharmacoepidemiology, pharmacy pedagogy, pharmaceutical microbiology, antimicrobial use, and antimicrobial resistance. Her research emphasizes the One Health approach and incorporates the Sustainable Development Goals.

Board of Studies

Prof. Dr. Muhammad Harris Shoaib
Dean
Faculty of Pharmacy and Pharmaceutical Sciences,
University of Karachi, Karachi

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Department of Pharmaceutics
University of Karachi, Karachi

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Dean, Faculty of Pharmacy,
University of Sindh, Jamshoro.

Dr. Anwar Ejaz Beg
Professor of Pharmaceutics and Advisor to Chancellor,
Faculty of Pharmacy, Ziauddin University, Karachi.

Dr. Zafar Alam Mehmood
Country Manager,
Colorcon (Pvt) Ltd, Karachi.

Pharm. D. Courses
First Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHT- 301	Physical Pharmacy - I	3	Core
PHT-303	Physical Pharmacy (Lab) - I	1	Core
Second Professional			
PHT-401	Drug Delivery and Formulation Science - I	3	Core
PHT-403	Drug Delivery and Formulation Science (Lab) - I	1	Core
PHT-417	Basic Pharmaceutical Microbiology	2	General Edu.
PHT-419	Basic Pharmaceutical Microbiology (Lab)	1	General Edu.
Fourth Professional			
PHT-601	Industrial Pharmacy – I	3	Core
PHT- 603	Industrial Pharmacy (Lab) - I	1	Core
PHT-605	Biopharmaceutics and Pharmacokinetics - I	3	Core
PHT-607	Biopharmaceutics and Pharmacokinetics (Lab) - I	1	Core
PHT-613	Expository Writing	3	General Edu.
PHT-615	Entrepreneurship	2	General Edu.
PHT-617	Pharmaceutical Marketing and Management	2	General Edu.
Fifth Professional			
PHT-701	Pharmaceutical Technology - I	3	Core
PHT-703	Pharmaceutical Technology (Lab) - I	1	Core
PHT-705	Pharmaceutical Quality Management Systems	3	Core

Pharm. D. Courses
Second Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHT-302	Physical Pharmacy - II	3	Core
PHT-304	Physical Pharmacy (Lab) - II	1	Core
Second Professional			
PHT-402	Drug Delivery and Formulation Science - II	3	Core
PHT-404	Drug Delivery and Formulation Science (Lab) - II	1	Core
PHT-406	Applied Pharmaceutical Microbiology and Immunology	3	Core
PHT-408	Applied Pharmaceutical Microbiology and Immunology (Lab)	1	Core
Third Professional			
PHT-516	Application of ICT {Information and Communication Technologies}	2	General Edu.
PHT-518	Application of ICT (Lab)	1	General Edu.
Fourth Professional			
PHT-602	Industrial Pharmacy - II	3	Core
PHT-604	Industrial Pharmacy (Lab) - II	1	Core
PHT-606	Biopharmaceutics and Pharmacokinetics - II	3	Core
PHT-608	Biopharmaceutics and Pharmacokinetics (Lab) - II	1	Core
Fifth Professional			
PHT-702	Pharmaceutical Technology - II	3	Core
PHT-704	Pharmaceutical Technology (Lab) - II	1	Core
Total **30 Courses** worth **60 Credit Hours** in five years			

Pharm. D. Courses – Outline
First Semester

PHT-301 | Cr. Hrs. 3
Physical Pharmacy I

Course Learning Outcomes

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

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

Contents

1. **Introduction to Pharmacy and History**
   - i. Introduction and orientation to the Pharmacy Profession with the current scope and latest applications.
   - 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.
   - iv. The developments in the 21st century, especially with reference to Biotechnology, nanotechnology, and artificial intelligence.

2. **Introduction to Pharmaceutical Literature**
   Introduction to the scientific literature, literature types in pharmacy, official texts and compendia, and their significance.

3. **Introductory concepts in Physical Pharmacy**
   - i. Fundamentals and overview of the concepts of physicochemical properties and their application in product development.
   - ii. Basic concepts of physical pharmacy in dosage forms science and its various applications.

4. **Physico-Chemical Principles**
   - i. Solutions: Types, concentration expressions, ideal and real solutions, colligative properties, and applications in pharmacy.
   - ii. Solubility and Solubilization: Definition and concepts of solubility and Solubilization, mechanism, factors affecting solubility and solubilization.
   - iii. Dissolution and Permeation: Definition and concepts, types, Factors affecting dissolution and permeation, Noyes-Whitney equation
   - iv. Polymorphism: Basic concept, lattice structure, and significance in pharmaceuticals. Amorphous and crystalline solids and their effect on thermodynamics. Role in dissolution.

5. **Ionization and Buffers**
   - i. Strong vs. Weak Electrolytes, pH, pKa, and buffer systems and capacity. Henderson- Hasselbalch Equation and application in drug formulation.
   - ii. Hypo, hyper, and Isotonic solutions and pharmaceutical applications.

6. **Micromeritics**
   - i. Particle size and its distribution, Texture and morphological characteristics of pharmaceutical powders. Role and importance in pharmacy and medicines.
   - ii. Methods of particle size analysis, distribution, and morphological determination (sieving, microscopy etc.).
   - iii. Flow properties: Carr's Index, Hausner's ratio, angle of repose.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. Anderson, S. (2005). Making Medicines: *A Brief History of Pharmacy and Pharmaceuticals:* Pharmaceutical Press.
5. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
6. 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.
7. 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.
9. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology: Wiley.*
10. Lovett, A. W. (2014). *Introduction to the Pharmacy Profession:* Jones & Bartlett Learning.
11. Ma, J. K. H., & Hadzija, B. (2013). Basic Physical Pharmacy: Jones & Bartlett Learning
12. 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.
14. 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
16. Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness:* Taylor & Francis.

PHT-303 | Cr. Hrs. 1

Physical Pharmacy (Lab) - I

Course Learning Outcomes

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

1. Explain basic physicochemical principles relevant to drug delivery systems and formulations.
2. Apply the physico-chemical principles in drug kinetics and drug stability.

Contents

1. Concepts of Physicochemical Principles and Applications.
2. Preparation of Solutions, Dilutions, and Construction of Standard Curve.
3. Understanding different expressions of concentration like Molarity (M), Normality (N), Percentage, etc
4. Study of different Solubility determination techniques with emphasis on solubility enhancement.
5. Buffer solutions: Calibration of a pH meter. Preparation of different official buffers.
6. Characterization of different powders based on particle size, Carr's Index, Hausner's ratio, angle of repose, etc.

Note: Minimum of 10 practical's shall be conducted

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. Anderson, S. (2005). Making Medicines: *A Brief History of Pharmacy and Pharmaceuticals:* Pharmaceutical Press.
5. British Pharmacopeia Commission (2024). *British Pharmacopeia* 2025. Medicines and Healthcare Products Regulatory Agency.

6. 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.
7. 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.
9. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology: Wiley.*
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11. Ma, J. K. H., & Hadzija, B. (2013). Basic Physical Pharmacy: Jones & Bartlett Learning
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14. 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
16. Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness*: Taylor & Francis.

PHT-401 | Cr. Hrs. 3

Drug Delivery and Formulation Science – I

Course Learning Outcomes

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

1. Explain the need for dosage forms with respect to routes of administration.
2. Develop different conventional dosage forms and drug delivery systems.

Contents

1. **Introduction to Dosage Forms and Drug Delivery Systems**
   i. Purpose of dosage forms and relation to routes of administration and bioavailability.
   ii. Concept of modern terminology of drug delivery systems and its various examples

2. **Selection of Dosage forms: Concept of pre-formulation studies, drug characteristics and other relevant information for the selection of suitable dosage forms**

3. **Solid Dosage Forms**
   i. Powders: Definition, properties, advantages, disadvantages, types, preparation.
   ii. Tablets: Definition, types, essentials, formulation, Granulation techniques, advantages and disadvantages.
   iii. Capsules: Hard and soft capsules, advantages, disadvantages, types.
   iv. Miscellaneous Solid Forms: Suppositories, medicated pencils, cements, surgical dressings, glycerogelatins.

4. **Basic Principles of Pharmaceutical Compounding and Extemporaneous Preparations**
   i. Weights and measures.
   ii. Calculation techniques for compounding and extemporaneous formulations.
   iii. Fundamental preparations in compounding.
   iv. Containers and closures for pharmaceutical products.
   v. Concept and practice of Good Compounding Practices.

5. **Pharmaceutical Incompatibilities**
   i. Types, manifestations, correction, and prevention (with examples).

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
5. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). Essential Pharmaceutics: Springer International Publishing
6. Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design:* OUP Oxford.
7. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.Gibson, *M. (2016). Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
8. Mahato, R. I., Narang, A. S., & Kumar, V. (2024). *Pharmaceutical Dosage Forms and Drug Delivery:* CRC Press.
9. Marriott, J. F. (2010). *Pharmaceutical Compounding and Dispensing*: Pharmaceutical Press.
10. Stockton, S. J. (2021). Stoklosa and Ansel's Pharmaceutical Calculations: Wolters Kluwer Health.
11. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
12. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
13. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-403 | Cr. Hrs. 1

Drug Delivery and Formulation Science (Lab) – I

Course Learning Outcomes

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

1. Apply various formulation techniques in the development of drug delivery systems.
2. Analyse the role of various pharmaceutical excipients in extemporaneous compounding.

Contents

1. Weighing Techniques for Solid and Liquid Formulations: Demonstrate balance calibration procedures and discuss environmental factors affecting balance performance. Demonstrate accurate weighing of APIs and excipients for solid and liquid preparations.
2. Compounding Practices for Different Dosage Forms: Demonstrate proper compounding methods to ensure dosage accuracy. 1) Use of volumetric glassware for measuring liquids. 2) Techniques for transferring liquids without contamination. Compounding Practices for Powders, Tablets, Capsules, and miscellaneous solid dosage forms such as suppositories, etc.
3. Liquid Dosage Forms for Oral and External Use: Aromatic water, Syrups, Spirits, Tinctures, Extracts, Elixirs, Linctus, Solutions, Drops, Lotions, and Liniments
4. Monophasic Liquid Dosage Forms for Special Use: Gargles, Mouthwashes, Paints, Ear drops, Nasal drops, Inhalations.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
5. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). Essential Pharmaceutics: Springer International Publishing
6. Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design:* OUP Oxford.
7. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.Gibson, M. (2016). *Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
8. Mahato, R. I., Narang, A. S., & Kumar, V. (2024). *Pharmaceutical Dosage Forms and Drug Delivery:* CRC Press.
9. Marriott, J. F. (2010). *Pharmaceutical Compounding and Dispensing:* Pharmaceutical Press.
10. Stockton, S. J. (2021). *Stoklosa and Ansel's Pharmaceutical Calculations:* Wolters Kluwer Health.

11. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
12. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
13. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-417 | Cr. Hrs. 2

Basic Pharmaceutical Microbiology

Course Learning Outcomes

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

1. Identify, classify, and signify the importance of microbes in ecosystems.
2. Describe the general characteristics and functional anatomy of microorganisms and their relevance in pharmaceutical applications.

Contents

1. **Introduction to Pharmaceutical Microbiology**
   i. Scope and historical foundation of Pharmaceutical Microbiology.
   ii. General characterization of microorganisms and nomenclature.

2. **Functional anatomy of bacteria.**
   i. Bacterial classification based on phenotype and genotype.
   ii. Nutritional requirements of bacteria: sources and functions of essential nutrients.
   iii. Bacterial growth and factors affecting growth.

3. **Microbial Techniques**
   i. Culture media and culturing techniques.
   ii. Obtaining and preserving pure cultures.
   iii. Visualizing bacteria: principles of microscopy and staining techniques.

4. **Environmental Microbiology**
   i. Microorganisms in the air, aquatic, and terrestrial environments.
   ii. Role of microorganisms in different ecosystems.

5. **Human-Microbiome Interactions**
   i. Normal microbiota and their significance.
   ii. Symbiosis, pathogenicity, and virulence.

6. **Diseases Caused by Microorganisms**
   i. Fungi, classification, cultivation techniques, disease-causing ability, identification, and characterization of few important diseases.
   ii. Protozoal and helminthic infections.
   iii. Representative bacterial infections (Gram-negative and Gram-positive bacteria).

7. **Pharmaceutical Applications of Microbes**
   i. Industrial microbiology and its role in pharmaceutical applications.
   ii. Microbial assessment of various dosage forms.

Recommended Reading

1. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
2. Brooks, G. F. (2013). *Jawetz Melnick & Adelbergs Medical Microbiology:* McGraw-Hill Education.
3. Carlton, R. A. (2011). *Pharmaceutical Microscopy:* Springer New York.
4. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology: Fundamentals and Applications*: Springer International Publishing.
5. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.

6. Finch, R. (2012). Antimicrobial Chemotherapy: OUP Oxford.
7. Gilmore, B. F., & Denyer, S. P. (2023). *Hugo and Russell's Pharmaceutical Microbiology:* Wiley.
8. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
9. Hanlon, G., & Hodges, N. A. (2012). *Essential Microbiology for Pharmacy and Pharmaceutical Science:* Wiley.
10. Lorian, V. (2005). Antibiotics in Laboratory Medicine: Lippincott Williams & Wilkins.
11. Pommerville, J. C. (2007). *Alcamo's Laboratory Fundamentals of Microbiology:* Jones & Bartlett Learning, LLC.
12. Roesti, D., & Goverde, M. (2019). *Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing:* Wiley.
13. Schwalbe, R., Steele-Moore, L., & Goodwin, A. C. (2007). *Antimicrobial Susceptibility Testing Protocols*: CRC Press.
14. Shen, W. C., & Louie, S. G. (2019). Immunology for Pharmacy Students: Taylor & Francis.
15. Tortora, G. J., Funke, B. R., & Case, C. L. (2013). *Microbiology: An Introduction:* Pearson.
16. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-419 | Cr. Hrs. 1

Basic Pharmaceutical Microbiology (Lab)

Course Learning Outcomes

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

1. Demonstrate the principles and techniques of microbial control.
2. Interpret and analyze microbial data with respect to regulatory compliance

Contents

1. **Orientation and Introduction to Laboratory Tools:**
   Introduction to lab equipment, apparatus, and microbiological culture media.

2. **Fundamental Techniques in Microbiological Laboratory Analysis**
   i. Microscopy techniques, including simple staining and Gram staining.
   ii. Other staining procedures (spore, capsule etc)
   iii. Microbiological culture media preparation and sterilization.
   iv. Aseptic isolation and inoculation techniques.

3. **Biochemical Tests for Microorganism Identification e.g,**
   i. Catalase test.
   ii. Coagulase test.
   iii. Pyrogen test.

4. **Studying Microbial Growth**
   i. Culture characteristics of bacteria.
   ii. Bacterial growth curve analysis.
   iii. The effect of temperature, pH, and osmotic pressure on microbial growth.

Recommended Reading

1. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
2. Brooks, G. F. (2013). *Jawetz Melnick & Adelbergs Medical Microbiology:* McGraw-Hill Education.
3. Carlton, R. A. (2011). *Pharmaceutical Microscopy:* Springer New York.
4. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology: Fundamentals and Applications:* Springer International Publishing.
5. *European Pharmacopeia* (11th edition). European Directorate for the Quality of Medicines & Healthcare.
6. Finch, R. (2012). Antimicrobial Chemotherapy: OUP Oxford.
7. Gilmore, B. F., & Denyer, S. P. (2023). *Hugo and Russell's Pharmaceutical Microbiology*: Wiley.

8. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
9. Hanlon, G., & Hodges, N. A. (2012). *Essential Microbiology for Pharmacy and Pharmaceutical Science:* Wiley.
10. Lorian, V. (2005). Antibiotics in Laboratory Medicine: Lippincott Williams & Wilkins.
11. Pommerville, J. C. (2007). *Alcamo's Laboratory Fundamentals of Microbiology:* Jones & Bartlett Learning, LLC.
12. Roesti, D., & Goverde, M. (2019). Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing: Wiley.
13. Schwalbe, R., Steele-Moore, L., & Goodwin, A. C. (2007). *Antimicrobial Susceptibility Testing Protocols:* CRC Press.
14. Shen, W. C., & Louie, S. G. (2019). Immunology for Pharmacy Students: Taylor & Francis.
15. Tortora, G. J., Funke, B. R., & Case, C. L. (2013). *Microbiology:* An Introduction: Pearson.
16. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-601 | Cr. Hrs. 3

Industrial Pharmacy - I

Course Learning Outcomes

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

1. Describe various industrial operational techniques and applications in pharmaceutical manufacturing.
2. Understand the large-scale production equipment and their utilization

Contents

1. Mixing Operations

i. Fundamentals and Mechanisms: a) Objectives of mixing in pharmaceutical processes. b) Mechanisms of mixing: diffusion, convection, and shear.
ii. Factors Affecting Mixing: a) Particle size, shape, and density. b) Mixer geometry and speed. c) Material properties and flow characteristics.
iii. Mixing Equipment:
    a.Liquid/liquid, liquid/solid, and solid/solid mixing.
    b.Types of mixers: i) *Tumbling Mixers:* V-type, double cone. ii) *Agitator Mixers:* Paddle, turbine, propeller. iii) *Special Mixers:* Pneumatic, Entolator impact mixers. iv) *Mixers for Semisolids:* Beaters, kneaders, mixer-extruders.
iv. Mixing Indices: Evaluation of blend uniformity and homogeneity.

2. Size Reduction (Comminution)

i. Purpose and Importance: Reasons for size reduction: enhancing dissolution, uniformity, and processing.
ii. Factors Influencing Size Reduction: Material properties, equipment design, operational parameters.
iii. Equipment: Sieving, energy mills (ball mill, edgerunner, edge runner mill). Colloid mill, hammer mill, cutter mill, fluid energy mill.

3. Drying Operations

i. Theories and Mechanisms: a) Moisture content, equilibrium moisture, and drying rate. B) Rate of drying curve: constant rate period and falling rate period.
ii. Factors Affecting Drying: Temperature, humidity, airflow, and material properties.
iii. Drying Equipment: Tray dryer, drum dryer, spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.
iv. Applications: Drying of solids, granules, and powders.

4. Filtration and Clarification

i. Principles and Theory: Mechanisms of filtration: size exclusion, adsorption, and depth filtration.

ii. Filter Media and Aids: Types of filter media: membrane, depth, and surface filters. Use of filter aids to enhance filtration efficiency.
iii. Filtration Equipment: Plate and frame filter, cartridge filter, vacuum filter. Clarification techniques for liquids.

5. Evaporation
i. General Principles: Evaporation as a concentration process. Factors affecting evaportion rate: temperature, surface area, vapor pressure.
ii. Evaporators: Types: steam jacketed kettles, horizontal and vertical tube evaporators. Forced circulation evaporators, multiple effect evaporators.
iii. Applications: Concentration of solutions in pharmaceutical manufacturing.

6. Compression and Compaction
i. Solid-Air Interface: Angle of repose, flow rates, and mass-volume relationships.
ii. Density and Consolidation: Bulk density, tapped density, and compressibility index.
iii. Granulation: Wet and dry granulation methods. Importance of granule properties in compression.
iv. Compression Techniques: Tablet compression and slugging. Heckle analysis, physics of tableting: force, pressure, and material behavior.
v. Tableting Equipment: Tablet presses, tooling, and tooling design.
vi. Common problems in tableting and troubleshooting.

7. Tablet Coating
i. Coating Techniques: a) Pan coating, air suspension coating. b) Film coating: aqueous and non-aqueous systems.
ii. Coating Equipment: Coating pans, fluidized bed coaters. Spray systems and coating parameters.
iii. Common problems in coating and troubleshooting

8. Encapsulation
i. Capsule Types: a) Hard gelatin capsules: filling techniques, sealing methods. b) Soft gelatin capsules: manufacturing processes, filling materials.
ii. Encapsulation Equipment: a) Capsule filling machines.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Allen, L. V. (2017). *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems:* Wolters Kluwer Health.
4. Augsburger, L. L., & Hoag, S. W. (2016). *Pharmaceutical Dosage Forms - Tablets:* CRC Press.
5. Augsburger, L. L., & Hoag, S. W. (2017). Pharmaceutical Dosage Forms: Capsules: CRC Press.
6. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
7. 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.
8. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). *Essential Pharmaceutics:* Springer International Publishing.
9. Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design:* OUP Oxford.
10. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
11. Fahr, A., & Scherphof, G. L. (2018). Voigt's *Pharmaceutical Technology*: Wiley.
12. Florence, A. T., & Siepmann, J. (2016). *Modern Pharmaceutics, Two Volume Set:* CRC Press.
13. Hickey, A. J., & Giovagnoli, S. (2025). *Pharmaceutical Powder and Particles:* Springer Nature Switzerland.
14. Koo, O. M. Y. (2016). *Pharmaceutical Excipients: Properties, Functionality, and Applications in Research and Industry:* Wiley.
15. Nayak, A. K., Pal, K., Banerjee, I., Maji, S., & Nanda, U. (2021). *Advances and Challenges in Pharmaceutical Technology: Materials, Process Development and Drug Delivery Strategies:* Academic Press.
16. Nema, S., & Ludwig, J. D. (2016). *Pharmaceutical Dosage Forms - Parenteral Medications: Volume 3: Regulations, Validation and the Future:* CRC Press.
17. Parikh, D. M. (2024). *Handbook of Pharmaceutical Granulation Technology:* Taylor & Francis Group.
18. Patravale, V. B., Disouza, J. I., & Rustomjee, M. (2016). *Pharmaceutical Product Development: Insights Into*

Pharmaceutical Processes, Management and Regulatory Affairs: CRC Press.
19. Qiu, Y., Chen, Y., Zhang, G. G. Z., Yu, L., & Mantri, R. V. (2016). Developing Solid Oral Dosage Forms: Pharma ceutical Theory and Practice: Academic Press.
20. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print)*: Taylor & Francis.
21. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
22. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-603 | Cr. Hrs. 1

Industrial Pharmacy (Lab) - I

Course Learning Outcomes

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

1. Evaluation and application of different equipment used in pharmaceutical manufacturing and assessment of the different parameters of the manufacturing area.

Contents

1. Relative Humidity Evaluation: Determination of relative humidity using Hygrometer at room temperature and in an air-conditioned room.
2. Moisture Content Determination: Determination of moisture content and loss on drying of given materials.
3. Size Reduction and Milling: Size reduction of the given material using Cutter Mill and Ball Mill.
4. Granulation Process: Use of Fluid Bed Granulator and Dryer for preparing granules.
5. Tablet Preparation Methods: Tablets preparation by direct compression, wet grantion, and dry granulation methods.
6. Compression and Compaction Analysis: a) Evaluation of tabletability, manufacturability, compressibility, compactability. b) Determining yield pressure by Heckel analysis. c) USP 1062 profiling.
7. Defects in Tablet Manufacturing: a) Identification of defects arising during tablet manufacturing and remedies for those defects. b) Find the defects for the given tablets and draw control charts for fraction defective tablets.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Allen, L. V. (2017). *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems:* Wolters Kluwer Health.
4. Augsburger, L. L., & Hoag, S. W. (2016). *Pharmaceutical Dosage Forms - Tablets:* CRC Press.
5. Augsburger, L. L., & Hoag, S. W. (2017). Pharmaceutical Dosage Forms: Capsules: CRC Press.
6. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
7. 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.
8. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). *Essential Pharmaceutics:* Springer International Publishing.
9. Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design:* OUP Oxford.
10. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
11. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
12. Florence, A. T., & Siepmann, J. (2016). *Modern Pharmaceutics, Two Volume Set:* CRC Press.
13. Hickey, A. J., & Giovagnoli, S. (2025). *Pharmaceutical Powder and Particles:* Springer Nature Switzerland.
14. Koo, O. M. Y. (2016). *Pharmaceutical Excipients: Properties, Functionality, and Applications in Research and Industry:* Wiley.

15. Nayak, A. K., Pal, K., Banerjee, I., Maji, S., & Nanda, U. (2021). *Advances and Challenges in Pharmaceutical Technology: Materials, Process Development and Drug Delivery Strategies:* Academic Press.
16. Nema, S., & Ludwig, J. D. (2016). *Pharmaceutical Dosage Forms - Parenteral Medications: Volume 3: Regulations, Validation and the Future:* CRC Press.
17. Parikh, D. M. (2024). *Handbook of Pharmaceutical Granulation Technology:* Taylor & Francis Group.
18. Patravale, V. B., Disouza, J. I., & Rustomjee, M. (2016). *Pharmaceutical Product Development: Insights Into Pharmaceutical Processes, Management and Regulatory Affairs:* CRC Press.
19. Qiu, Y., Chen, Y., Zhang, G. G. Z., Yu, L., & Mantri, R. V. (2016). Developing Solid Oral Dosage Forms: Pharma ceutical Theory and Practice: Academic Press.
20. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
21. Taylor, K., & *Aulton, M. E. (2021). Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
22. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-605 | Cr. Hrs. 3

Biopharmaceutics and Pharmacokinetics - I

Course Learning Outcomes

After completion of this course the students will be able to

1. Demonstrate the inter-relationship of the physico-chemical properties of the drug, the dosage forms and the route of administration.
2. Demonstrate the Principles of bioavailability, bioequivalence and data analysis.

Contents

1. Introduction and fundamentals of Biopharmaceutics and Pharmacokinetics: Biopharmacetics, biopharmaceutics classification system (BCS), Pharmacokinetics, drug disposition, bioavailability and bioequivalence.
2. Drug Absorption: Drug absorption mechanisms, Physicochemical, physiological and formulation factors affecting drug bioavailability. Absorption of different oral dosage forms.
3. Biopharmaceutics of Topical, Transdermal, inhalation and injectable formulations.
4. Biopharmaceutics assessment using in vitro, in silico, in situ and ex vivo tools.
5. Bioavailability and Bioequivalence: Introduction, Bioavailability types, parameters, significance and study protocol, Methods of Assessment of Bioavailability, Bioequivalence study designs, components and application, Biowaivers.
6. Drug Metabolism and Elimination: Drug Metabolism, Drug Elimination, Drug Biotransformation reactions, (Phase-I reactions and phase-II reactions), First pass effect.
7. Drug Excretion and Clearance: Renal excretion, Tubular Secretion and Tubular Reabsorption. Pulmonary excretion, Biliary excretion, salivary excretion, Mammilary excretion, Skin excretion and Genital excretion. Drug clearance and factors affecting drug clearance.
8. Protein Binding: Introduction, types, kinetics, determination and clinical significance of drug-protein binding.
9. Biopharmaceutical Aspects in Developing a Dosage Form: Role of biopharmaceutics in developing a new dosage form. Biopharmaceutical evaluation of dosage forms.
10. Biopharmaceutics classification system (BCS). Introduction to invitro in vivo (IVIVC) correltion studies.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). I*ntegrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Banakar, U. V. (2021). Pharmaceutical Dissolution Testing, Bioavailability, and Bioequivalence: Science, Applications, and Beyond: Wiley.
4. Batchelor, H. (2021). *Biopharmaceutics: From Fundamentals to Practice*: Wiley.

5. Berner, B., Gordi, T., Benson, H. A. E., & Roberts, M. S. (2021). *Drug Delivery Approaches: Perspectives from Pharmacokinetics and Pharmacodynamics:* Wiley.
6. Boroujerdi, M. (2015). Pharmacokinetics and Toxicokinetics: Taylor & Francis.
7. Chow, S. C., & Liu, J. (2009). Design and Analysis of Bioavailability and Bioequivalence Studies: CRC Press.
8. Curry, S. H., & Whelpton, R. (2022). *Drug Disposition and Pharmacokinetics: Principles and Applications for Medicine, Toxicology and Biotechnology:* Wiley.
9. Derendorf, H., & Schmidt, S. (2019). *Rowland and Tozer's Clinical Pharmacokinetics and Pharmacodynam ics: Concepts and Applications:* Wolters Kluwer Health.
10. Dressman, J. B., & Reppas, C. (2016). Oral Drug Absorption: Prediction and Assessment, Second Edition: CRC Press.
11. Ducharme, M. P., Shargel, L., & Yu, A. B. C. (2022). *Shargel and Yu's Applied Biopharmaceutics & Pharmaco kinetics, 8th Edition:* McGraw Hill LLC.
12. Jambhekar, S. S., & Breen, P. J. (2024). *Basic Pharmacokinetics:* Pharmaceutical Press.
13. Krishna, R., & Yu, L. (2010). Biopharmaceutics Applications in Drug Development: Springer US.
14. Mukherjee, B. (2022). *Pharmacokinetics: Basics to Applications:* Springer Nature Singapore.
15. Niazi, S. K. (2014). Handbook of Bioequivalence Testing, Second Edition: Taylor & Francis.
16. Rosenbaum, S. E. (2016). *Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer Simulations:* Wiley.
17. Sarmento, B., Pereira, C. L., & Das Neves, J. (2024). Concepts and Models for Drug Permeability Studies: Cell and Tissue based In Vitro Culture Models: Woodhead Publishing.
18. Steffansen, B., Brodin, B., & Nielsen, C. U. (2010). Molecular Biopharmaceutics: Aspects of Drug Characteri sation, Drug Delivery and Dosage Form Evaluation: Pharmaceutical Press.
19. Sugano, K. (2012). *Biopharmaceutics Modeling and Simulations: Theory, Practice, Methods, and Applitions:* Wiley.
20. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
21. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*: Elsevier.
22. Washington, N., Washington, C., & Wilson, C. (2000). Physiological Pharmaceutics: Barriers to Drug Absorption: Taylor & Francis.

PHT-607 | Cr. Hrs. 1

Biopharmaceutics and Pharmacokinetics (Lab) - I

Course Learning Outcomes

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

1. Demonstrate the inter-relationship of the physico-chemical properties of the drug, the dosage forms and the route of administration.

Contents

1. Ionization Studies: Investigate the effect of various physiological pH on the percentage ionization of different drugs.
2. Permeability Assessments: Conduct permeability studies of selected drugs, including acidic salt of weakly basic drugs and basic salt of weakly acidic drugs, , Dialysis membranes, Franz diffusion cells.
3. Partition Coefficient Determinations: Determine the true partition coefficient and distribution coefficient of selected drugs.
4. Effective Permeability Coefficient: Determine the apparent/effective permeability coefficient of selected drugs.
5. Noyes-Whitney Equation Application: Study the effect of Noyes-Whitney's equation parameters on the percentage drug release.
6. Formulation and Process Variables: Examine the impact of different formulation and process variables on the percentage drug release.
7. In Vitro-In Vivo Correlation (IVIVC): Develop IVIVC for two model drugs by comparing dissolu-tion profiles with in-vivo data.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Banakar, U. V. (2021). Pharmaceutical Dissolution Testing, Bioavailability, and Bioequivalence: Science, Applications, and Beyond: Wiley.
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22. Washington, N., Washington, C., & Wilson, C. (2000). Physiological Pharmaceutics: Barriers to Drug Absorption: Taylor & Francis.

PHT-613 | Cr. Hrs. 3

Expository Writing

Course Learning Outcomes

By the end of the course students will be able to:

1. Understand the essentials of the writing process by integrating pre-writing, drafting, editing, and proofreading to produce well-structured essays relevant to pharmacy.
2. Demonstrate proficiency in diverse expository writing forms to address varied academic and professional purposes across pharmacy disciplines.
3. Uphold ethical practices and apply critical thinking to develop original, well-substantiated written work aligned with scientific and regulatory standards.

Contents

1. **Introduction to Expository Writing**
   - Definition, types, and purpose of expository writing.
   - Characteristics of effective writing (clarity, coherence, organization).
   - Paragraph writing and essay basics.
   - Applications in pharmacy-related documentations and communication.

2. **The Writing Process**
   - Pre-writing techniques (brainstorming, free-writing, mind-mapping, outlining).
   - Drafting techniques (multi-stage drafting for clarity and depth).
   - Revising, editing, and proofreading.
   - Peer review and giving/receiving feedback.

3. **Essay & Document Structure**
   - Introduction and hook (engaging readers).
   - Crafting strong thesis statements.
   - Body paragraphs (topic sentences, supporting evidence, transitions).
   - Effective conclusions (different approaches for impact).
   - Cohesion and coherence across essays and reports.
   - Mechanics of scientific language (precision, vocabulary, paraphrasing, rephrasing).

4. **Types of Expository Writing**
   - Description and illustration.
   - Classification and division.
   - Cause and effect analysis.
   - Process analysis (e.g., standard operating procedures).
   - Comparative analysis (e.g., therapeutic alternatives).

5. **Writing for Specific Purposes and Audiences**
   - Writing to inform, analyze, persuade, and educate.
   - Academic writing: scholarly essays, literature reviews, research proposals, case analyses, manuscripts, theses/dissertations.
   - Professional writing: SOPs, GMP documents, QA protocols, regulatory dossiers, product labeling, package inserts.
   - Public and patient-focused writing: medication guides, patient education leaflets, health campaigns.
   - Adjusting tone, style, and technical depth for audiences (patients, clinicians, regulators, researchers).

6. **Ethics and Integrity in Writing**
   - Academic and professional integrity.
   - Avoiding plagiarism (quoting, paraphrasing, summarizing responsibly).
   - Proper citation and referencing styles (APA, MLA, Vancouver).
   - Transparency in presenting data (avoiding misrepresentation, disclosing limitations).
   - Respect for confidentiality (patient data, proprietary information).
   - Responsible use of generative AI in academic and professional writing.

Recommended Reading

1. Graff, G., & Birkenstein, C. (2024). They Say / I Say: The Moves That Matter in Academic Writing (6th ed.). W. W. Norton & Company.
2. Rosenwasser, D., & Stephen, J. (2023). Writing Analytically (9th ed.). Cengage.
3. Axelrod, R. B., & Cooper, C. R. (2021). The St. Martin's Guide to Writing (13th ed.). Bedford/St. Martin's.
4. Strunk, W., & White, E. B. (2000). The Elements of Style (4th ed.). Longman.
5. Booth, W. C., Colomb, G. G., Williams, J. M., Bizup, J. & Fitzgerald W. T. (2009). The Craft of Research (5th ed.). University of Chicago Press.
6. Hofmann, A. H. (2023). Scientific writing and communication. Oxford University Press.
7. Coven, M. B. (2022). Writing on the Job: Best Practices for Communicating in the Digital Age. Princeton University Press.
8. Klinkenborg, V. (2012). Several Short Sentences About Writing. Vintage.

PHT-615 | Cr. Hrs. 2

Entrepreneurship

Course Learning Outcomes

By the end of this course, students will be able to:

1. Understand entrepreneurship fundamentals in the pharmaceutical industry.
2. To utilize the foundational knowledge and skills in entrepreneurship, emphasizing leadership, effective communication, ethical considerations, and essential awareness within the pharmaceutical sector.
3. Communicate effectively in professional and business settings.
4. Explore entrepreneurial opportunities in Pakistan's pharmaceutical landscape.

Contents

1. **Introduction to Entrepreneurship**
   - Myths and realities of entrepreneurship
   - Types: commercial, social, intrapreneurship (pharmacy-focused)

2. **Entrepreneurial Mindset & Opportunity Recognition**
   - Characteristics of entrepreneurs. Identifying gaps in pharmacy services and products
   - Opportunity recognition frameworks (VIDE, tournament method)

3. **Innovation & MVP Development**
   - Creative problem-solving in pharmacy and pharmaceutical sciences
   - Minimum Viable Product (MVP) concept & prototyping methods. Designing a quick MVP
   - Lean Canvas & Business Model Canvas
   - Product vs. service-based ventures
   - *Assignment 1:* Draft of business model canvas for a pharmacy idea

4. **Team Formation & Equity Allocation**
   - Founding team dynamics (skills vs. personality)
   - Equity splits & founder agreements
   - *Activity:* Role-play equity negotiation for a 3-member pharmacy startup

5. **Market Research & Competitive Analysis**
   - Market segmentation & targeting (patients, hospitals, retail)
   - Competitor mapping & positioning strategies
   - *Assignment 2:* Market research survey design

6. **Regulatory & Legal Framework**
   - Licensing, DRAP & SECP requirements
   - Overview of Good Pharmacy Practices (GPP), GMP for manufacturing
   - Intellectual property: patents, trademarks, trade secrets
   - *Assignment 3:* List required licenses for a chosen startup

7. **Financing Basics**
   - Sources of funding (bootstrapping, loans, angels, VC, crowdfunding)
   - Revenue models & streams in pharmacy startups
   - *Activity:* Analyze financial model of a local pharmacy chain

8. **Advanced Financing & Profitability**
   - Valuation methods, break-even, burn rate
   - Negotiating term sheets
   - Exit strategies: IPO, acquisition, partnerships
   - *Assignment 4:* Break-even analysis of a pharmacy retail venture

9. **Growth Strategies**
   - Scaling operations & managing growth
   - Customer acquisition & adoption curves
   - KPIs & metrics for pharmacy businesses
   - *Workshop:* Create KPIs for a telemedicine + pharmacy delivery startup

10. **Leadership & Team Management**
   - Entrepreneurial leadership styles
   - Conflict resolution & negotiation in startups
   - Building culture in small teams
   - *Activity:* Leadership self-assessment exercise

11. **Ethics & Professionalism**
   - Ethical challenges in pharmacy entrepreneurship
   - Balancing profit with patient safety & access

12. **Ethics & Professionalism**
   - Pitch deck preparation (problem, solution, business model, financials, team, market)
   - Peer review of draft business plans & feedback
   - Mentorship session with entrepreneur/VC guest

Recommended Reading

1. Zorich, George S. Entrepreneurs in Pharmacy: And Other Leaders. Outskirts Press, 2017.
2. George S. Zorich. Entrepreneurs in Pharmacy and Other Leaders: Strategies and Stories for Success, 2nd Edition, 2024.
3. Management, Leadership and Entrepreneurship in Pharmacy, Zubin Austin, 2023
4. The Lean Startup – Eric Ries, *Modern classic on building and scaling startups with minimum waste.*
5. Business Model Generation – Alexander Osterwalder & Yves Pigneur, *Visual handbook for business model design, introducing the Business Model Canvas.*
6. Innovation and Entrepreneurship – Peter F. Drucker, *Foundational text covering entrepreneurial principles, opportunities, and practice.*
7. The Startup Owner's Manual – Steve Blank & Bob Dorf, *Step-by-step customer development guide for startups*

Supplementary Reading

1. Zero to One: Notes on Startups, or How to Build the Future – Peter Thiel, *Explores creating unique ventures instead of copying existing models.*
2. Disciplined Entrepreneurship: 24 Steps to a Successful Startup – Bill Aulet (MIT), *Practical toolkit for turning ideas into real businesses.*
3. Blue Ocean Strategy – W. Chan Kim & Renée Mauborgne, *Framework for creating uncontested market space and avoiding competition traps.*
4. Delivering Happiness – Tony Hsieh (Zappos CEO), *On building company culture, customer focus, and sustainable growth.*
5. The Art of the Start 2.0 – Guy Kawasaki, *Practical, startup-friendly guide covering pitching, branding, and funding.*
6. Pakistan Startup Ecosystem Report – Invest2Innovate (i2i), Karandaaz Pakistan, or World Bank reports, *Annual ecosystem mapping with case studies of Pakistani entrepreneurs.*

PHT-617 | Cr. Hrs. 2

Pharmaceutical Marketing and Management

Course Learning Outcomes

By the end of the course, students will be able to:

1. Explain core marketing concepts, mix models (4Ps, 7Ps), and their evolution in pharma and retail contexts.

2. Apply STP strategies and stakeholder engagement for patients, prescribers, payers, and regulators.
3. Analyze leadership styles, organizational roles, and cross-functional coordination in pharma marketing.
4. Evaluate supply chain models, inventory systems, pricing, and pharmacoeconomic approaches for market access.
5. Design ethical, regulation-compliant marketing and retail pharmacy plans using traditional and digital tools.

Contents

1. **Introduction, Evolution and Development of Marketing**
   - Marketing concepts and social functions of marketing
   - Historical milestones. Global vs. local perspectives

2. **Marketing Principles & Mix (4Ps, 7Ps)**
   - Foundational models. Rx vs OTC, generic vs brand

3. **Pharmaceutical Industry and Retail Pharmacy Environment**
   - Macro & micro-environments
   - Trends in global pharma & healthcare systems
   - Retail pharmacy landscape: business models, regulation, operations

4. **Segmentation, Targeting & Positioning (STP)**
   - Patient, prescriber & payer segmentation
   - Value propositions (customers' needs/demands/value)

5. **Stakeholder Relationships**
   - Patients & physicians, Physicians & industry
   - KOLs & payers (marketing circles & constituents)

6. **Organizational Coordination & Management**
   - Marketing vs. medical affairs vs. regulatory roles (cross-functional teams)
   - Medical Affairs & Scientific Engagement (Role of MSLs, Publications and CMEs)
   - Styles of leadership & management (autocratic, democratic, transformational, situational, servant). Corporate structures, norms & challenges

7. **Ethics, Regulation & Guiding Principles**
   - DRAP, IFPMA, WHO codes, Promotion compliance & pharmacovigilance

8. **Pharmaceutical Supply Chain Fundamentals**
   - Key actors: manufacturers, distributors, wholesalers, retailers, hospitals.
   - Supply chain models (push vs pull, direct-to-pharmacy, tender-based systems).
   - Regulation & Quality in Supply Chains (DRAP, WHO guidelines and Cold Chain requirements)
   - Risks and Challenges: Counterfeit drugs, diversion, corruption.
   - Geopolitical and infrastructure constraints in Pakistan. Ensuring resilience in crises (pandemics, disasters).
   - Role of supply efficiency in market penetration.

9. **Pharmaceutical Inventory & Stock Management**
   - Forecasting demand for medicines and preventing stockouts, expired medicines, and shortages.
   - ERP and digital inventory tools in pharma.

10. **Pricing & Reimbursement Strategies**
    - Pricing models, market access, Health Technology Assessment. (HTA)

11. **Pharmacoeconomics & Outcomes Research**
    - QALYs, cost-effectiveness, budget impact
    - Patient access programs

12. Promotion: Sales & Relationship Marketing
    - Sales force effectiveness (marketing effectiveness)
    - Customs in inner circles (sales practices & detailing ethics)

13. **Promotion: Digital & Omnichannel Marketing**
    - eDetailing, CME platforms, social media campaigns. Metrics & analytics.

14. **Strategic Marketing & Retail Pharmacy Business Planning Launch planning, brand life cycle**
    - Marketing plans for pharmaceuticals (Student Pitching and Plans).
    - Retail pharmacy business models: inventory control, merchandising, HR (Student Pitching and Plans).

Recommended Reading

1. Pharmacy Management, Third Edition 3rd Edition. by Shane Desselle, David Zgarrick, Greg Alston
2. Essentials of Pharmacy Management Second Edition; Edited by Dennis H Tootelian, Albert I; Wertheimer, Andrey;
3. Kotler, P., Keller, K. L. (2016). *Marketing Management* (15th ed.). Pearson.
4. Smith, M. C. (2020). *Principles of Pharmaceutical Marketing*. Routledge.
5. David P. Zgarrick., et al. (2019). *Pharmacy Management: Essentials for All Practice Settings* (5th ed.). McGraw-Hill Education

Specialized Pharma & Health References

1. World Health Organization (WHO). *Good Distribution Practices (GDP) Guidelines*.
2. International Federation of Pharmaceutical Manufacturers & Associations (IFPMA). *Code of Practice*.
3. Pharmaceutical Research and Manufacturers of America (PhRMA). *Code on Interactions with Health Care Professionals*.

PHT-701 | Cr. Hrs. 3

Pharmaceutical Technology - I

Course Learning Outcomes

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

1. Explore the recent advancements in pharmaceutical technologies.
2. Describe and demonstrate the emerging concepts and techniques in the development of novel drug delivery systems.

Contents

1. **Novel Drug Delivery Systems: Definitions and Concepts:**
   Modified release, controlled release, extended release, delayed release, and targeted drug delivery. Matrix systems, membrane systems, osmotic systems. Buccal, gastroretetive, stimuli responsive DDS, colon-specific drug delivery systems, Hydrogels and other polymeric NDDS.

2. **Polymers for Modified Release Drug Delivery Systems:**
   Types, applications and examples.

3. **Advanced Drug Delivery Routes:**
   Transdermal, ocular, pulmonary, and nasal drug delivery systems.

4. **Pharmaceutical Nanotechnology:**
   Overview and formulation of polymeric nanoparticles, nanotubes, nanospheres, nanocap sules, dendrimers, liposomes, niosomes, nano-hydrogels, spray-dried particles, gold nanoparticles.

5. **QbD-Based Formulation Development for Modified Release Systems:**
   Concept of Quality by Design (QbD), risk management, design of experiments, software tools for formulation design.

6. **Artificial Intelligence (AI) and Machine Learning in Drug Delivery:**
   Role of AI in controlled release, Artificial Neural Networks (ANN), AI-based formulation and process design tools.

7. **Emerging Technologies in Pharmaceutical Sciences:**
   Introduction and applications of 3D/4D/5D Printing in Pharmaceuticals, hotmelt extrusion technology and Electerospinning technology.

8. **Introduction and Fundamentals of Computational Pharmaceutics**

Recommended Reading

1. Azar, A. T. (2021). *Modeling and Control of Drug Delivery Systems:* Academic Press.
2. Benson, H. A. E., Roberts, M. S., Williams, A. C., & Liang, X. (2021). *Fundamentals of Drug Delivery*: Wiley.
3. Bhupathyraaj, M., Rani, K. R. V., & Essa, M. M. (2023). *Artificial intelligence in Pharmaceutical Sciences*: CRC Press.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
5. Bruschi, M. L. (2015). *Strategies to Modify the Drug Release from Pharmaceutical Systems:* Woodhead Publishing.
6. Cornier, J., Owen, A., Kwade, A., & Van de Voorde, M. (2016). *Pharmaceutical Nanotechnology: Innovation and Production:* Wiley.
7. Donnelly, R. F., & Singh, T. R. R. (2015). *Novel Delivery Systems for Transdermal and Intradermal Drug Delivery:* Wiley.
8. Donnelly, R. F., Singh, T. R. R., Morrow, D. I. J., & Woolfson, A. D. (2012). *Microneedle- mediated Transdermal and Intradermal Drug Delivery:* Wiley.
9. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
10. Florence, A. T., & Siepmann, J. (2016). *Modern Pharmaceutics, Two Volume Set:* CRC Press.
11. Ghosh, T. K. (2020). *Dermal Drug Delivery: From Innovation to Production:* CRC Press.
12. Gibson, M. (2016). *Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
13. Grumezescu, A. M. (2017). *Nanoscale Fabrication, Optimization, Scale-up and Biological Aspects of Pharmaceutical Nanotechnology:* Elsevier.
14. Hillery, A., & Park, K. (2016). *Drug Delivery: Fundamentals and Applications, Second Edition:* CRC Press.Ita, K. (2020). T*ransdermal Drug Delivery: Concepts and Application:* Academic Press.
15. Martins, J. P., & Santos, H. A. (2020). *Nanotechnology for Oral Drug Delivery: From Concept to Applications:* Elsevier Science.
16. Mohapatra, S., Ranjan, S., Dasgupta, N., Thomas, S., & Mishra, R. K. (2018). *Nanocarriers for Drug Delivery: Nanoscience and Nanotechnology in Drug Delivery:* Elsevier Science.
17. Nayak, A. K., Pal, K., Banerjee, I., Maji, S., & Nanda, U. (2021). *Advances and Challenges in Pharmaceutical Technology: Materials, Process Development and Drug Delivery Strategies:* Academic Press.
18. Opara, E. (2023). *Controlled Drug Delivery Systems: T*aylor & Francis Group.
19. Ouyang, D., Smith, S. C., Douroumis, D., Fahr, A., Siepmann, J., Snowden, M. J., & Torchilin, V. P. (2015). *Computational Pharmaceutics: Application of Molecular Modeling in Drug Delivery:* Wiley Press.
20. Rathbone, M., Hadgraft, J., Roberts, M. S., & Lane, M. E. (2008). *Modified-Release Drug Delivery Technology:* CRC Press.
21. Saharan, V. A. (2022). *Computer Aided Pharmaceutics and Drug Delivery: An Application Guide for Students and Researchers of Pharmaceutical Sciences: S*pringer Nature Singapore.
22. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
24. Vizirianakis, I. S. (2014). *Handbook of Personalized Medicine: Advances in Nanotechnology, Drug Delivery, and Therapy:* Pan Stanford.
25. Washington, N., Washington, C., & Wilson, C. (2000). *Physiological Pharmaceutics: Barriers to Drug Absorption:* Taylor & Francis.
26. Weissig, V., & Elbayoumi, T. (2020). *Pharmaceutical Nanotechnology: Basic Protocols:* Springer New York.
27. Wen, H., & Park, K. (2011). *Oral Controlled Release Formulation Design and Drug Delivery: Theory to Practice:* Wiley.

28. Wilson, C. G., & Crowley, P. J. (2011). *Controlled Release in Oral Drug Delivery:* Springer US.

PHT-703 | Cr. Hrs. 1

Pharmaceutical Technology (Lab) - I

Course Learning Outcomes

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

1. Explore the recent advancements in pharmaceutical technologies.
2. Describe and demonstrate the emerging concepts and techniques in the development of novel drug delivery systems.

Contents

1. Pre-formulation evaluation of pharmaceutical excipients: Detailed micromeritic characterization of various powders (bulk density, tapped density, Carr's Index, Hausner's Ratio) and particle size analysis using frequency distribution and plots.
2. Formulation development and optimization by Quality by Design (QbD) and Artificial Intelligence AI): Application of DoE methodologies like Central Composite Design (CCD), Factorial Design, Box-Behnken Design in development of tablet formulations.
3. Development, validation, and calibration of manufacturing processes: Blending time, drying time, compression force analysis.
4. Determination and comparison of dissolution profiles: Perform comparative dissolution profiling using model-dependent (zero-order, first-order, Higuchi, Korsmeyer-Peppas, Baker-Lonsdale) and model-independent (f1, f2 factors) methods.
5. Preparation of matrix tablets: For poorly and highly water-soluble drugs (polymer selection and manufacturing method selection and optimization).
6. Preparation and characterization of matrix-based and coated pellets: Pelletization, spheronization, geometry, and surface analysis using stereomicroscope.
7. Comparison and evaluation of swelling and disintegration profiles: Physical analysis of expired vs. valid film-coated, enteric-coated tablets and hard gelatin capsules.

Recommended Reading

1. Azar, A. T. (2021). *Modeling and Control of Drug Delivery Systems:* Academic Press.
2. Benson, H. A. E., Roberts, M. S., Williams, A. C., & Liang, X. (2021). *Fundamentals of Drug Delivery:* Wiley.
3. Bhupathyraaj, M., Rani, K. R. V., & Essa, M. M. (2023). *Artificial intelligence in Pharmaceutical Sciences:* CRC Press.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
5. Bruschi, M. L. (2015). *Strategies to Modify the Drug Release from Pharmaceutical Systems*: Woodhead Publishing.
6. Cornier, J., Owen, A., Kwade, A., & Van de Voorde, M. (2016). *Pharmaceutical Nanotechnology: Innovation and Production:* Wiley.
7. Donnelly, R. F., & Singh, T. R. R. (2015). *Novel Delivery Systems for Transdermal and Intradermal Drug Delivery:* Wiley.
8. Donnelly, R. F., Singh, T. R. R., Morrow, D. I. J., & Woolfson, A. D. (2012). *Microneedle- mediated Transdermal and Intradermal Drug Delivery:* Wiley.
9. *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare.
10. Florence, A. T., & Siepmann, J. (2016). M*odern Pharmaceutics, Two Volume Set*: CRC Press.
11. Ghosh, T. K. (2020). *Dermal Drug Delivery: From Innovation to Production:* CRC Press.
12. Gibson, M. (2016). P*harmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
13. Grumezescu, A. M. (2017). *Nanoscale Fabrication, Optimization, Scale-up and Biological Aspects of Pharmaceutical Nanotechnology:* Elsevier.
14. Hillery, A., & Park, K. (2016). *Drug Delivery: Fundamentals and Applications, Second Edition:* CRC Press.Ita, K.

(2020). *Transdermal Drug Delivery: Concepts and Application*: Academic Press.
15. Martins, J. P., & Santos, H. A. (2020). *Nanotechnology for Oral Drug Delivery: From Concept to Applications:* Elsevier Science.
16. Mohapatra, S., Ranjan, S., Dasgupta, N., Thomas, S., & Mishra, R. K. (2018). *Nanocarriers for Drug Delivery: Nanoscience and Nanotechnology in Drug Delivery:* Elsevier Science.
17. Nayak, A. K., Pal, K., Banerjee, I., Maji, S., & Nanda, U. (2021). *Advances and Challenges in Pharmaceutical Technology: Materials, Process Development and Drug Delivery Strategies:* Academic Press.
18. Opara, E. (2023). *Controlled Drug Delivery Systems:* Taylor & Francis Group.
19. Ouyang, D., Smith, S. C., Douroumis, D., Fahr, A., Siepmann, J., Snowden, M. J., & Torchilin, V. P. (2015). *Computational Pharmaceutics: Application of Molecular Modeling in Drug Delivery:* Wiley Press.
20. Rathbone, M., Hadgraft, J., Roberts, M. S., & Lane, M. E. (2008). *Modified-Release Drug Delivery Technology:* CRC Press.
21. Saharan, V. A. (2022). *Computer Aided Pharmaceutics and Drug Delivery: An Application Guide for Students and Researchers of Pharmaceutical Sciences:* Springer Nature Singapore.
22. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
24. Vizirianakis, I. S. (2014). *Handbook of Personalized Medicine: Advances in Nanotechnology, Drug Delivery, and Therapy:* Pan Stanford.
25. Washington, N., Washington, C., & Wilson, C. (2000). *Physiological Pharmaceutics: Barriers to Drug Absorption:* Taylor & Francis.
26. Weissig, V., & Elbayoumi, T. (2020). *Pharmaceutical Nanotechnology: Basic Protocols:* Springer New York.
27. Wen, H., & Park, K. (2011). *Oral Controlled Release Formulation Design and Drug Delivery: Theory to Practice:* Wiley.
28. Wilson, C. G., & Crowley, P. J. (2011). *Controlled Release in Oral Drug Delivery:* Springer US.

PHT-705 | Cr. Hrs. 3

Pharmaceutical Quality Management System

Course Learning Outcomes

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

1. Identify components of quality management systems in the manufacturing of therapeutic goods.
2. Document the industrial compliance protocols.
3. Practice quality assurance and its applications in the manufacturing of therapeutic goods

Contents

1. Fundamentals of Quality in Pharmaceuticals
- i. Definition of Quality and its significance in drug manufacturing
- ii. Determinants of Drug Quality, International Drug Compendia (USP, BP, JP, IP)
- iii. Global Regulatory Bodies (FDA, EMA, WHO, MHRA, DRAP), Conformance

2. Introduction to Pharmaceutical Quality Management System (PQM)
- i. Elements and Description of PQM, Key Objectives and Principles of QMS
- ii. Overview of Major QMS Models: ICH Q10, ISO 9001:2015, FDA 21 CFR Part 820 (Quality System Regulation)
- iii. Definition and Objectives of Good Manufacturing Practices (cGMP)
- iv. Overview of International cGMP Guidelines: WHO GMP, FDA 21 CFR Part 211, PIC/S, ISPE, MHRA, EU, DRAP
- v. Good Documentation Practices (GDP) and Good Storage Practices (GSP)

3. Core Components of QMS
- i. Quality Manual and Standard Operating Procedures (SOPs)
- ii. Good Documentation Practices and ALCOA Principles, Approval, Update, and Archival of Documents
- iii. Drug Master Files (DMFs) / Active Pharmaceutical Ingredients (APIs)

iv. cGMP Training and Competency Development, Production and Packaging Operations under QMS

4. Validation in the Pharmaceutical Industry
- i. Introduction to Validation: Definition, Scope, and Regulatory Basis
- ii. Validation and Qualification; Calibration and Verification
- iii. Validation Master Plan (VMP)
- iv. Types of Validation: Prospective Process Validation (life-cycle approach), Retrospective Process Validation and Concurrent Validation
- v. Cleaning Validation and Validation of Sterilization Methods
- vi. Validation of Water and Air Handling Systems and Computerized Systems

5. Quality Risk Management (QRM)
- i. Overview of ICH Q9: Definition, Principles, and Risk Lifecycle
- ii. Steps in Risk Management: Risk Assessment, Control, and Review
- iii. Common Tools for QRM: FMEA, FTA, HACCP, Ishikawa/Fishbone, Risk Ranking
- iv. Linkage of QRM with Product Development (ICH Q8)

6. Pharmaceutical Quality System (PQS)
- i. Overview of ICH Q10 and Lifecycle Stage Goals, Management Responsibilities in Quality Systems
- ii. Enablers: Knowledge Management and Quality Risk Management Integration
- iii. Corrective and Preventive Actions (CAPA): Definition and Objectives, Process Steps, Documentation and Effectiveness Monitoring

7. Pharmaceutical Annual Product/Quality Review (APQR / PAQR)
- i. Purpose and Importance of APQR
- ii. Components and Structure of APQR
- iii. Process of Conducting APQR and Role of APQR in Continuous Improvement
- iv. Integration with CAPA and Product Lifecycle Management

8. Emerging Trends in Pharmaceutical Quality Systems
- i. Industry 4.0: Automation, AI, IoT, and Smart Factories
- ii. Role of Big Data and Data Integrity
- iii. Process Analytical Technology (PAT)
- iv. Continuous Manufacturing and Real-Time Release Testing (RTRT)

Recommended Reading

1. Akers, M. J. (2016). *Sterile Drug Products: Formulation, Packaging, Manufacturing and Quality:* CRC Press.
2. Asif, E. S. (2021). *Pharmaceutical Vendors Approval Manual: A Comprehensive Quality Manual for API and Packaging Material Approval:* CRC Press.
3. Botet, J. (2015). *Good Quality Practice (GQP) in Pharmaceutical Manufacturing: A Handbook:* Bentham Science Publishers, Limited.
4. Breitkreitz, M. C., & Goicoechea, H. (2023). *Introduction to Quality by Design in Pharmaceutical Manufactur ing and Analytical Development:* Springer International Publishing
5. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
6. Çelik, M. (2016). *Pharmaceutical Powder Compaction Technology*: CRC Press.
7. *European Pharmacopeia (11th edition)*. European Directorate for the Quality of Medicines & Healthcare.
8. Gad, S. C. (2008). *Pharmaceutical Manufacturing Handbook: Regulations and Quality*: Wiley.
9. Ghante, M., Potdar, M., & Bhusari, V. (2024). *Modern Aspects of Pharmaceutical Quality Assurance: Devel oping & Proposing Application models, SOPs, practical audit systems for Pharma Industry:* Springer Nature Singapore.
10. Guide for API, Finished Pharmaceutical and Biotechnologies Laboratories: CRC Press.
11. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
12. Haider, S. I., & Asif, E. S. (2018). *Quality Control Training Manual: Comprehensive Training:* CRC Press
13. Jain, N. K., & Bajwa, N. (2024). *Introduction to Quality by Design (QbD): From Theory to Practice:* Springer Nature Singapore.
14. Jameel, F., Hershenson, S., Khan, M. A., & Martin-Moe, S. (2016). *Quality by Design for Biopharmaceutical Drug Product Development:* Springer New York.

15. Kolhe, P., Shah, M., & Rathore, N. (2016). *Sterile Product Development: Formulation, Process, Quality and Regulatory Considerations:* Springer New York.
16. Mittal, B. (2019). *How to Integrate Quality by Efficient Design (QbED) in Product Development:* Elsevier Science.
17. Patravale, V. B., Disouza, J. I., & Rustomjee, M. (2016). *Pharmaceutical Product Development: Insights Into Pharmaceutical Processes, Management and Regulatory Affairs:* CRC Press.
18. Schlindwein, W. S., & Gibson, M. (2018). *Pharmaceutical Quality by Design: A Practical Approach:* Wiley.
19. Shargel, L., & Kanfer, I. (2013). *Generic Drug Product Development: Solid Oral Dosage Forms, Second Edition:* CRC Press.
20. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
21. Welty, G. (2013). *Quality Assurance: Problem Solving and Training Strategies for Success in the Pharmaceu tical and Life Science Industries:* Woodhead Publishing.
22. Wingate, G. (2016). *Pharmaceutical Computer Systems Validation: Quality Assurance, Risk Management and Regulatory Compliance:* CRC Press.

Pharm. D. Courses – Outline
Second Semester

PHT-302 | Cr. Hrs. 3

Physical Pharmacy - II

Course Learning Outcomes

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

1. Explain basic physicochemical principles relevant to drug delivery systems and formulations.

Contents

1. **Surface and Interfacial Phenomena**
   - i. Surface and interfacial tension.
   - ii. Types of surfactants, techniques to reduce surface tension, and pharmaceutical appltions.
   - iii. Micellization and its application in dosage forms.

2. **Adsorption: Mechanisms, types of adsorption, adsorption isotherms.**

3. **Disperse Systems**
   - i. Colloids: Introduction, types, methods of preparation, optical/kinetic/electrical proper ties, stability and pharmaceutical applications.
   - ii. 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.

4. **Rheology**
   - i. Fluid flow behaviors, rheograms.
   - ii. Newtonian and non-Newtonian liquids.
   - iii. Thixotropy, anti-thixotropy, and rheopexy.
   - iv. Factors affecting and significance in pharmaceutical formulations.

5. **Stability Studies in Pharmacy**
   - i. Introduction, factors affecting stability, types of stability studies.

ii. Rate of reactions and order of kinetics
iii. Drug degradation: Phase separation, hydrolysis, oxidation, photolysis and other pathways of drug degradation. Role of pH, temperature and ionic strength.

6. **Unit Operations in Pharmacy**
   i. Introduction to terminologies and concepts of Precipitation, crystallization, evaporation, distillation, efflorescence, deliquescence, lyophilization, elutriation, desiccation, ignition, fusion, sublimation, calcination, decantation, adsorption, centrifugation, trituration, levigation, and dialysis.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. Anderson, S. (2005). *Making Medicines: A Brief History of Pharmacy and Pharmaceuticals:* Pharmaceutical Press.
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9. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
10. Lovett, A. W. (2014). *Introduction to the Pharmacy Profession:* Jones & Bartlett Learning.
11. Ma, J. K. H., & Hadzija, B. (2013). Basic Physical Pharmacy: Jones & Bartlett Learning
12. 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.
14. 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
16. Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness:* Taylor & Francis.

PHT-304 | Cr. Hrs. 1

Physical Pharmacy (Lab) - II

Course Learning Outcomes

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

1. Explain basic physicochemical principles relevant to drug delivery systems and formulations.
2. Apply the physico-chemical principles in drug kinetics and drug stability.

Contents

1. **Chemical Kinetics:**
   i. Effect of temperature on the stability of a model drug by determining reaction rate constant; determining the order of reaction (zero-order, first-order);
   ii. Determination of expiry date using the Arrhenius equation.

2. **Interfacial Phenomena:**
   i. Determining Critical Micelle Concentration (CMC) of different surfactants.
   ii. Determination of flocculation volume of a given suspension and effect of surfactant concentration on flocculation volume.

3. **Rheology:**
   i. Determination of the viscosity of different systems.
   ii. Plotting rheograms after shearing the system and determining rheological charactertics.
   iii. Studying the effect of viscosity on the stability of suspensions.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. Anderson, S. (2005). Making Medicines: *A Brief History of Pharmacy and Pharmaceuticals:* Pharmaceutical Press.
5. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
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9. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
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15. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention
16. Zebroski, B. (2015). *A Brief History of Pharmacy: Humanity's Search for Wellness:* Taylor & Francis.

PHT-402 | Cr. Hrs. 3

Drug Delivery and Formulation Science – II

Course Learning Outcomes

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

1. Explain the need for dosage forms with respect to routes of administration.
2. Develop different conventional dosage forms and drug delivery systems.

Contents

1. **Parenteral Dosage Forms**
   i. Definition, history, types, advantages, disadvantages, and uses.
   ii. Formulation components, vehicles, containers, and closures.
   iii. Concept of sterile/aseptic area

2. **Semi-solid Dosage Forms**
   i. Ointments: Bases, methods of preparation, and application
   ii. Miscellaneous Semi-solids: Creams, pastes, poultices, plasters. Liniments.

3. **Introduction to Novel Drug Delivery Systems**
   i. Overview of novel drug delivery systems, types, and various examples.
   ii. Introduction to Cosmeceuticals.

4. **I.V. Admixtures**
   i. Preparation, stability, and compatibility issues.

5. **Introductions of Radiopharmaceuticals**
   i. Formulation, safety, regulation, and compounding aspects.

6. **Introductions and Preparation of Aerosols and Sprays**
   i. Fundamentals, preparation, types, and applications.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
5. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). Essential Pharmaceutics: Springer International Publishing
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8. Gibson, M. (2016). *Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
9. Mahato, R. I., Narang, A. S., & Kumar, V. (2024). *Pharmaceutical Dosage Forms and Drug Delivery:* CRC Press.
10. Marriott, J. F. (2010). *Pharmaceutical Compounding and Dispensing:* Pharmaceutical Press.
11. Stockton, S. J. (2021). *Stoklosa and Ansel's Pharmaceutical Calculations:* Wolters Kluwer Health.
12. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
13. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
14. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-404 | Cr. Hrs. 1

Drug Delivery and Formulation Science (Lab) – II

Course Learning Outcomes

At the end of this course the student will be able to:
1. Apply various formulation techniques in the development of drug delivery systems.
2. Analyse the role of various pharmaceutical excipients in extemporaneous compounding.

Contents

1. **Biphasic Liquid Dosage Forms:**
   i. Suspensions
   ii. Emulsions
   iii. Magmas
   iv. Gels

2. **Pharmaceutical Powders: Divided powders, Bulk powders:**

3. **Pharmaceutical Semi-Solid Preparations:**
   i. Ointments
   ii. Creams
   iii. Pastes
   iv. Gels

4. **Capsule Filling: Manual capsule filling, Semi-automatic capsule filling using bench-top machine**

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. 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.
4. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025.* Medicines and Healthcare Products Regulatory Agency.
5. Brunaugh, A. D., Moraga-Espinoza, D., Bahamondez-Canas, T. F., Smyth, H. D. C., & Williams, R. O. (2024). Essential Pharmaceutics: Springer International Publishing
6. Denton, P., & Rostron, C. (2013). *Pharmaceutics: The Science of Medicine Design:* OUP Oxford.
7. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
8. Gibson, M. (2016). *Pharmaceutical Preformulation and Formulation: A Practical Guide from Candidate Drug Selection to Commercial Dosage Form:* CRC Press.
9. Mahato, R. I., Narang, A. S., & Kumar, V. (2024). *Pharmaceutical Dosage Forms and Drug Delivery:* CRC Press.
10. Marriott, J. F. (2010). P*harmaceutical Compounding and Dispensing:* Pharmaceutical Press.
11. Stockton, S. J. (2021). S*toklosa and Ansel's Pharmaceutical Calculations:* Wolters Kluwer Health.
12. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
13. Tovey, G. D. (2018). *Pharmaceutical Formulation: The Science and Technology of Dosage Forms:* RSC.
14. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-406 | Cr. Hrs. 3

Applied Pharmaceutical Microbiology and Immunology

Course Learning Outcom

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

1. Describe the use of microbes in industrial processes and product developmen
2. Introduction to the human immune system and its theranostic application.

Contents

1. **Controlling Microorganisms: Disinfection, Preservation, and Sterilization:**
   - i. The terminology of microbial control and sensitivity of microorganisms.
   - ii. Survivor plots, sterility assurance level, and sterilization kinetics.
   - iii. Physical methods of microbial control.
   - iv. Chemical agents for microbial control.
   - v. Bioburden determination and environmental monitoring.

2. **Development of Antimicrobial Chemotherapeutic Agents:**
   - i. Classification of antimicrobials according to spectrum of activity & mechanism.
   - ii. Development of antibmicrobial products: history and advances
   - iii. Bactdreial Resistance against antibiotics.

3. **Viruses, Viroids, and Prions:**
   - i. General characteristics of viruses, viral structure, and classification (Baltimore classification).
   - ii. Growing and visualizing viruses in the lab.
   - iii. Multiplication of viruses.
   - iv. Diseases caused by DNA and RNA viruses.
   - v. Healthcare-associated infections (HAIs) and mechanisms of transfer.
   - vi. Common causative agents of HAIs and prevention methods.
   - vii. Representative diseases with causative agent, morphology, diagnosis, pathogenesis, clinical implication and treatment of few important viral diseases.

4. **Introduction to the human immune system and its theranostic applications.**
   - i. Introduction and types of Immunity: Innate (non-specific) and Adaptive (specific)

immunity
ii. Cellular & humoral components of immunity
iii. Autoimmunity, tolerance and immune disorders
iv. Antigen Antibody reactions and their clinical and diagnostic applications.
v. Hypersensitivity reactions and their clinical implications.
vi. Vaccination and Immunization

Recommended Reading

1. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
2. Brooks, G. F. (2013). *Jawetz Melnick & Adelbergs Medical Microbiology:* McGraw-Hill Education.
3. Carlton, R. A. (2011). *Pharmaceutical Microscopy:* Springer New York.
4. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology:* Fundamentals and Applications: Springer International Publishing.
5. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
6. Finch, R. (2012). Antimicrobial Chemotherapy: OUP Oxford.
7. Gilmore, B. F., & Denyer, S. P. (2023). *Hugo and Russell's Pharmaceutical Microbiology:* Wiley.
8. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
9. Hanlon, G., & Hodges, N. A. (2012). *Essential Microbiology for Pharmacy and Pharmaceutical Science:* Wiley.
10. Lorian, V. (2005). Antibiotics in Laboratory Medicine: Lippincott Williams & Wilkins.
11. Pommerville, J. C. (2007). *Alcamo's Laboratory Fundamentals of Microbiology:* Jones & Bartlett Learning, LLC.
12. Roesti, D., & Goverde, M. (2019). *Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing:* Wiley.
13. Schwalbe, R., Steele-Moore, L., & Goodwin, A. C. (2007). *Antimicrobial Susceptibility Testing Protocols*: CRC Press.
14. Shen, W. C., & Louie, S. G. (2019). *Immunology for Pharmacy Students*: Taylor & Francis.
15. Tortora, G. J., Funke, B. R., & Case, C. L. (2013). *Microbiology: An Introduction:* Pearson.
16. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-408 | Cr. Hrs. 1

Applied Pharmaceutical Microbiology and Immunology (Lab)

Course Learning Outcome,.

At the end of this course the student will be able to:
1. Demonstrate the principles and techniques of microbial control
2. Interpret and analyze microbial data with respect to regulatory compliance.

Contents

1. **Control of Microorganisms Using Physical and Chemical Methods**
   i. Sterilization using moist heat, dry heat, ultraviolet radiation, and filtration.
   ii. Studying the effectiveness of different antiseptics and disinfectants.

2. **Preservative Efficacy Testing (PET)**
   i. Challenge test with common bacterial and fungal lab strains

3. **Antibiotic Susceptibility Testing**
   i. Kirby-Bauer antibiotic disc diffusion assay.
   ii. MIC determination using agar and broth dilution method.

4. **Sterility and Endotoxin Testing**
   i. Sterility test.
   ii. Pyrogen test

5. **Environmental Sampling and Bioburden Testing**
   i. Settle plate method to determine bioburden in the air.
   ii. Qualitative and quantitative analysis of water.

Recommended Reading

1. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
2. Brooks, G. F. (2013). *Jawetz Melnick & Adelbergs Medical Microbiology:* McGraw-Hill Education.
3. Carlton, R. A. (2011). *Pharmaceutical Microscopy:* Springer New York.
4. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology: Fundamentals and Applications:* Springer International Publishing.
5. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
6. Finch, R. (2012). Antimicrobial Chemotherapy: OUP Oxford.
7. Gilmore, B. F., & Denyer, S. P. (2023). *Hugo and Russell's Pharmaceutical Microbiology:* Wiley.
8. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
9. Hanlon, G., & Hodges, N. A. (2012). *Essential Microbiology for Pharmacy and Pharmaceutical Science:* Wiley.
10. Lorian, V. (2005). Antibiotics in Laboratory Medicine: Lippincott Williams & Wilkins.
11. Pommerville, J. C. (2007). *Alcamo's Laboratory Fundamentals of Microbiology:* Jones & Bartlett Learning, LLC.
12. Roesti, D., & Goverde, M. (2019). *Pharmaceutical Microbiological Quality Assurance and Control: Practical Guide for Non-Sterile Manufacturing:* Wiley.
13. Schwalbe, R., Steele-Moore, L., & Goodwin, A. C. (2007). *Antimicrobial Susceptibility Testing Protocols*: CRC Press.
14. Shen, W. C., & Louie, S. G. (2019). *Immunology for Pharmacy Students:* Taylor & Francis.
15. Tortora, G. J., Funke, B. R., & Case, C. L. (2013). *Microbiology: An Introduction*: Pearson.
16. Unite*d States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-516 | Cr. Hrs. 2

Application of Information and Communication Technologies (ICT)

Course Learning Outcomes

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

1. Explain the fundamental concepts, components, and scope of Information and Communication Technologies (ICT) with relevance to pharmaceutical sciences, education, research, and healthcare.
2. Identify and describe the applications of various ICT platforms and digital tools used in pharmacy settings, including hospital, community, regulatory, and industrial domains.
3. Discuss and analyze the role of ICT in digital health, telemedicine, e-pharmacy, pharmacovigilance, and pharmaceutical data management systems.
4. Recognize and evaluate ethical, legal, and professional considerations related to digital identity, intellectual property, data security, and responsible use of ICT in healthcare.

Contents

1. **Introduction to Information and Communication Technologies (ICT)**
   - Overview of ICT and its importance in modern education and pharmacy.
   - Hardware, software, networks, and cloud computing basics.
   - Data storage systems: local vs. cloud.
   - Emerging technologies: Artificial Intelligence, Machine Learning, Internet of Things (IoT), Blockchain in healthcare, and digital transformation in the pharmaceutical industry.

   Pharmacy Context: Examples of digital pharmacy systems, AI-based drug discovery, e-pre scriptions, and smart manufacturing.

2. **ICT Productivity and Communication Tools**
   - Search engines and scientific databases (Google Scholar, PubMed, ResearchGate).
   - Academic and professional email etiquette.
   - Microsoft Office Suite and Google Workspace: Word (report and SOP writing for pharma ceuticals). Excel (data entry, calculations for formulations, charts). PowerPoint (scientific presentation preparation).
   - File management and cloud storage (Google Drive, OneDrive, Dropbox).
   - Digital note-taking (OneNote, Evernote).
   - Video conferencing and collaboration (Zoom, Teams, Google Meet).
   - Social media for professional networking (LinkedIn, ResearchGate, Academia.edu).

   Pharmacy Context: Writing laboratory reports, formulation sheets, APQR templates, data summaries, and scientific posters.

3. **ICT in Education and Research**
   - Learning Management Systems (Moodle, Google Classroom).
   - Accessing online courses and certifications (Coursera, edX, etc.).
   - Digital libraries (HEC Digital Library, PubMed, ScienceDirect).
   - Reference management tools (Mendeley, Zotero).
   - Plagiarism detection tools (Turnitin, Grammarly).

   Pharmacy Context: Using ICT for literature reviews, research proposal development, data colletion, and online learning.

4. **ICT in Health and Pharmaceutical Practice**
   - Electronic Health Records (EHR), e-prescribing systems, and pharmacy management software.
   - Telepharmacy and telemedicine platforms in Pakistan (Sehat Kahani, Marham).
   - Mobile health apps and fitness tracking.
   - Pharmacovigilance and digital reporting systems (MedSafety App, DRAP's online ADR portal).

   Pharmacy Context: Medication safety, patient counseling, digital prescriptions, and online ADR reporting.

5. **ICT in Personal Finance and E-commerce**
   - Online banking, mobile payment systems (JazzCash, Easypaisa).
   - E-commerce in pharmaceuticals (Daraz Health, Dvago, emeds).
   - Digital marketing in pharmacy and ethical concerns.

6. **Digital Citizenship, Ethics, and Legal Issues**
   - Digital identity and professional online presence.
   - Online etiquette and respectful communication.
   - Cybersecurity, cyberbullying, and data privacy.
   - Copyright, plagiarism, and intellectual property.
   - Ensuring accuracy and authenticity in digital health information.

   Pharmacy Context: Ethical sharing of patient data, avoiding plagiarism in research, verifying medical information online.

Recommended Reading

1. HEC ICT Curriculum (latest revision).
2. Shelly, G.B., & Vermaat, M.E. Discovering Computers: Digital Technology, Data, and Devices.
3. Curtin, D.P., Foley, K., Morin, A., & Sen, M. Information Technology: The Breaking Wave.
4. HEC Digital Library Resources.
5. Online resources: PubMed, Coursera, WHO Digital Health guidelines, DRAP MedSafety App documenttion.
6. Discovering Computers" by Vermaat, Shaffer, and Freund.
7. GO! with Microsoft Office" Series by Gaskin, Vargas, and McLellan.
8. Exploring Microsoft Office" Series by Grauer and Poatsy.
9. Computing Essentials" by Morley and Parker.
10. Technology in Action" by Evans, Martin, and Poatsy.

PHT-518 | Cr. Hrs. 1

Application of Information and Communication Technologies (ICT; Lab)

Course Learning Outcomes

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

1. Demonstrate proficiency in using common productivity software (MS Word, Excel, PowerPoint) to prepare, analyze, and present pharmacy-related documents and datasets.
2. Apply file management and cloud collaboration tools (Google Drive, OneDrive) for organizing, sharing, and maintaining pharmaceutical and academic records.
3. Utilize online tools for course participation, assignment submission, and professional communication.
4. Integrate ICT tools to create, compile, and submit a mini-project simulating real-world pharmaceutical documentation and reporting tasks.

Contents

1. Orientation and Digital Setup: Introduction to ICT lab environment, file organization, folder creation, and file-naming conventions using local and cloud storage (Google Drive, OneDrive); organizing pharmacy-related documents and reports.
2. Word Processing for Pharmaceutical Documentation: Guided tutorial on Microsoft Word — creating, formatting, and editing professional pharmaceutical documents such as lab reports, Standard Operating Procedures (SOPs), and official letters.
3. Spreadsheet Applications in Pharmaceutics: Practical exercises in Microsoft Excel for data entry, performing basic calculations (mean, SD), and creating charts for drug release profiles or stability study data.
4. Presentation Design for Scientific Communication: Using Microsoft PowerPoint to design and deliver short presentations on pharmaceutical topics (e.g., formulation development, drug delivery systems).
5. File Management and Cloud Collaboration: Creating, managing, and sharing folders and files through cloud platforms (Google Drive, OneDrive); practicing version control and collaborative document editing on pharmacy projects.
6. Use of Learning Management Systems (LMS): Accessing course materials, uploading assign ments, participating in discussion forums, and taking quizzes on an LMS (Google Classroom or Moodle) to simulate online academic environments.
7. Digital Research and Reference Management: Searching scientific databases (PubMed, ScienceDirect), saving references, and using citation tools (Mendeley, Zotero) for pharmaceutical literature.
8. Final Project and Digital Submission: Integration exercise — preparing a complete mini-prect (report in Word, data in Excel, and presentation in PowerPoint) on a selected pharmaceutical topic and submitting it through LMS.

Recommended Reading

1. HEC ICT Curriculum (latest revision).
2. Shelly, G.B., & Vermaat, M.E. *Discovering Computers: Digital Technology, Data, and Devices.*
3. Curtin, D.P., Foley, K., Morin, A., & Sen, M. *Information Technology: The Breaking Wave.*
4. HEC Digital Library Resources.
5. Online resources: PubMed, Coursera, WHO Digital Health guidelines, DRAP MedSafety App documenttion.
6. Discovering Computers" by Vermaat, Shaffer, and Freund.
7. GO! with Microsoft Office" Series by Gaskin, Vargas, and McLellan.
8. Exploring Microsoft Office" Series by Grauer and Poatsy.
9. Computing Essentials" by Morley and Parker.
10. Technology in Action" by Evans, Martin, and Poatsy

PHT-602 | Cr. Hrs. 3

Industrial Pharmacy - II

Course Learning Outcomes

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

1. Develop a pharmaceutical industry layout design with all its components.
2. Understand the role of manufacturing equipment design and developing new technologies in pharmaceutical engineering.

Contents

1. **Pharmaceutical Facility Design Principles**
   - i. Overview of pharmaceutical manufacturing facilities and their importance.
   - ii. Key concepts in facility design, including compliance with Good Manufacturing Practices (GMP) and international regulations. With special reference to Oral Solid Dosage (OSD), Semi-Solids, Liquid, Sterile Manufacturing, Packaging and Warehousing Facilities.
   - iii. Importance of process, personnel, and material flow in facility layout.

2. **Architectural Design Considerations**
   - i. Hygienic zones and design details to prevent contamination.
   - ii. Selection of materials for pharmaceutical manufacturing areas to ensure cleanliness and compliance.

3. **Facility Utility Systems**
   - i. Heating, Ventilation, and Air Conditioning (HVAC) Systems: Design and function of HVAC systems in pharmaceutical facilities and Importance of maintaining controlled environ ments for product quality and compliance.
   - ii. Other Utility Systems: a) Supply air handling, exhaust, and return air systems. b) Vapor and fume handling and treatment. c) Process and piping systems. d) Fire protection and electrical systems. e) Design considerations for hazardous areas.

5. **Regulatory Compliance and Safety Standards**
   - i. Overview of building and zoning codes relevant to pharmaceutical facilities.
   - ii. Occupational health and safety considerations, including: a) Accident prevention and control. b) Electrical safety and fire protection. c) Handling hazardous and reactive materials.

6. **Pressure Vessels, Reactors, and Fermenters:**
   a)Basics of pressure vessel design. b) Fundamentals of pharmaceutical reactors. c) Heat and mass transfer aspects of reactors. d) Safety and fire hazard considerations in reactors.

7. **Reliability, Availability, and Maintainability (RAM):**
   a) Introduction to RAM concepts. b) Role of reliability and maintainability in pharmactical manufacturing

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Agalloco, J. P., DeSantis, P., Grilli, A., & Pavell, A. (2022). *Handbook of Validation in Pharmaceutical Process* es: CRC Press.
3. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
4. Allen, L. V. (2017). *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems:* Wolters Kluwer Health.
5. Asif, E. S. (2021). *Pharmaceutical Vendors Approval Manual: A Comprehensive Quality Manual for API and Packaging Material Approval:* CRC Press.
6. Asif, E. S., & Usmani, S. B. (2024). Basics of Pharmaceutical Manufacturing and Quality Operations: A

Comprehensive Guide: CRC Press.
7. Augsburger, L. L., & Hoag, S. W. (2016). *Pharmaceutical Dosage Forms - Tablets:* CRC Press.
8. Augsburger, L. L., & Hoag, S. W. (2017). *Pharmaceutical Dosage Forms: Capsules:* CRC Press.
9. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
10. Bunn, G. P. (2019). Good Manufacturing Practices for Pharmaceuticals, Seventh Edition: CRC Press.
11. European Pharmacopeia (11th edition). European Directorate for the Quality of Medicines & Healthcare.
12. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
13. Haider, S. I. (2018). Cleaning Validation Manual: A Comprehensive Guide for the Pharmaceutical and Biotechnology Industries: Taylor & Francis Group.
14. Haider, S. I., & Asif, E. S. (2012). Quality Operations Procedures for Pharmaceutical, API, and Biotechnology: Taylor & Francis.
15. Haider, S. I., & Asif, E. S. (2018). Quality Control Training Manual: Comprehensive Training Guide for API, Finished Pharmaceutical and Biotechnologies Laboratories: CRC Press.
16. Hickey, A. J., & Ganderton, D. (2016). *Pharmaceutical Process Engineering:* CRC Press.
17. Hout, S. A. (2021). *Sterile Manufacturing: Regulations, Processes, and Guidelines:* CRC Press.
18. Jacobs, T., & Signore, A. A. (2022). *Good Design Practices for GMP Pharmaceutical Facilities:* CRC Press.
19. Kolhe, P., Shah, M., & Rathore, N. (2016). *Sterile Product Development: Formulation, Process, Quality and Regulatory Considerations:* Springer New York.
20. Prager, G. (2018). *Practical Pharmaceutical Engineering:* Wiley.
21. Qiu, Y., Chen, Y., Zhang, G. G. Z., Yu, L., & Mantri, R. V. (2016). Developing Solid Oral Dosage Forms: Pharma ceutical Theory and Practice: Academic Press.
22. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-604 | Cr. Hrs. 1

Industrial Pharmacy (Lab) - II

Course Learning Outcomes

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

1. Assess the impact of package and packaging materials and processes on pharmaceutical products.
2. Pharmaceutical quality evaluation and characterization by statistical analysis.

Contents

1. Ointment and Paste Preparation: Preparation of Ointment and Paste using Three Roller Mills.
2. Preparation of Effervescent Granules: Preparation of Effervescent Sodium Phosphate Graules using the fusion method.
3. Emulsion Preparation: Preparation of Emulsion using bench top industrial homogenizers.
4. Lyophilization Process: Preparation of Lyophilized formulation using Freeze dryers.
5. Film Coating Techniques: Aqueous film coating and non-aqueous film coating of the given tablets.
6. Sugar Coating of Tablets: Sugar Coating of the given tablets.
7. Enteric Coating: Enteric Coating of tablets.
8. Fluid Bed Coating: Fluid bed coating using Wurster Coater for pellets.
9. Single Point Dissolution Test: Single Point Dissolution test to evaluate tablet performance.
10. Statistical Evaluation of Pharmaceutical Quality: Quality evaluation of tablets using control charts and statistical analysis to assess manufacturing consistency.
    Note: Visit of at least five (05) renowned pharmaceutical industries.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Agalloco, J. P., DeSantis, P., Grilli, A., & Pavell, A. (2022). *Handbook of Validation in Pharmaceutical Process es:* CRC Press.
3. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product*

Design, and Regulatory Science: Wiley.
4. Allen, L. V. (2017). *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems:* Wolters Kluwer Health.
5. Asif, E. S. (2021). *Pharmaceutical Vendors Approval Manual: A Comprehensive Quality Manual for API and Packaging Material Approval:* CRC Press.
6. Asif, E. S., & Usmani, S. B. (2024). Basics of Pharmaceutical Manufacturing and Quality Operations: A Comprehensive Guide: CRC Press.
7. Augsburger, L. L., & Hoag, S. W. (2016). *Pharmaceutical Dosage Forms - Tablets:* CRC Press.
8. Augsburger, L. L., & Hoag, S. W. (2017). *Pharmaceutical Dosage Forms: Capsules:* CRC Press.
9. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
10. Bunn, G. P. (2019). Good Manufacturing Practices for Pharmaceuticals, Seventh Edition: CRC Press.
11. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
12. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
13. Haider, S. I. (2018). Cleaning Validation Manual: A Comprehensive Guide for the Pharmaceutical and Biotechnology Industries: Taylor & Francis Group.
14. Haider, S. I., & Asif, E. S. (2012). Quality Operations Procedures for Pharmaceutical, API, and Biotechnology: Taylor & Francis.
15. Haider, S. I., & Asif, E. S. (2018). Quality Control Training Manual: Comprehensive Training Guide for API, Finished Pharmaceutical and Biotechnologies Laboratories: CRC Press.
16. Hickey, A. J., & Ganderton, D. (2016). *Pharmaceutical Process Engineering:* CRC Press.
17. Hout, S. A. (2021). Sterile Manufacturing: *Regulations, Processes, and Guidelines:* CRC Press.
18. Jacobs, T., & Signore, A. A. (2022). *Good Design Practices for GMP Pharmaceutical Facilities:* CRC Press.
19. Kolhe, P., Shah, M., & Rathore, N. (2016). *Sterile Product Development: Formulation, Process, Quality and Regulatory Considerations:* Springer New York.
20. Prager, G. (2018). *Practical Pharmaceutical Engineering:* Wiley.
21. Qiu, Y., Chen, Y., Zhang, G. G. Z., Yu, L., & Mantri, R. V. (2016). *Developing Solid Oral Dosage Forms: Pharma ceutical Theory and Practice:* Academic Press.
22. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
23. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convetion.

PHT-606 | Cr. Hrs. 3

Biopharmaceutics and Pharmacokinetics - II

Course Learning Outcomes

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

1. Analyze the pharmacokinetic behavior of drug administered different routes and pathological condition.
2. Principles of bioavailability, bioequivalence and data analysis.
3. Understand pharmacokinetic modelling and its applications.

Contents

1. **Pharmacokinetics:**
   Introduction, Linear and Non-linear Pharmacokinetics Application of pharmacokinetics in various situations. Pharmacokinetics and its related fields (Clinical Pharmacokinetics, population pharmacokinetics, Pharmacodynamics, Toxicokinetic, Clinical toxicology, clinical pharmacology, forensic science, therapeutic drug monitoring, pharmacogenetics).

2. **Biological Half Life and Volume of Distribution:**
   Zero order and first order half-life, factors affecting and application of half-life. Apparent volume of distribution, concepts and factors affecting volume of distribution.

3. **Pharmacokinetic modelling:**
   Introduction and types of PK modelling, Compartment models, Non-compartmental approach, Concept and PK parameters after IV bolus single dose administration. Coment models for extravascular administration of Drugs. Application of compartment models to

determine various PK parameters of extra-vascularly administered drugs. Concepts of Wagner-Nelson Method, Flip-flop Phenomenon, Loo-Riegelman Method.

4. **Multiple Dosage Regimen:**
   Introduction, concept and PK parameters in Multiple dosing Pharmacokinetics after IV administration, Drug Accumulation and Principle of superposition.

5. **Pharmacokinetics of Intravenous Infusions:**
   Introduction and assessment of various parameters in Pharmacokinetics of IV infusion.

6. **Pharmacokinetics Variations in Disease States:**
   Determination of pharmacokinetics variations in renal and hepatic diseases, general approaches for dose adjustment in renal and hepatic diseases.

7. **Pharmacokinetic and Pharmacodynamic (PK/PD) correlation.**

8. **Introduction to in-silico mechanistic modelling for physiologically based pharmacokinetic (PBPK) and whole body PBPK.**

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). I*ntegrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Banakar, U. V. (2021). Pharmaceutical Dissolution Testing, Bioavailability, and Bioequivalence: Science, Applications, and Beyond: Wiley.
4. Batchelor, H. (2021). *Biopharmaceutics: From Fundamentals to Practice:* Wiley.
5. Berner, B., Gordi, T., Benson, H. A. E., & Roberts, M. S. (2021). *Drug Delivery Approaches: Perspectives from Pharmacokinetics and Pharmacodynamics:* Wiley.
6. Boroujerdi, M. (2015). *Pharmacokinetics and Toxicokinetics:* Taylor & Francis.
7. Chow, S. C., & Liu, J. (2009). Design and Analysis of Bioavailability and Bioequivalence Studies: CRC Press.
8. Curry, S. H., & Whelpton, R. (2022). *Drug Disposition and Pharmacokinetics: Principles and Applications for Medicine, Toxicology and Biotechnology:* Wiley.
9. Derendorf, H., & Schmidt, S. (2019). *Rowland and Tozer's Clinical Pharmacokinetics and Pharmacodynam ics: Concepts and Applications:* Wolters Kluwer Health.
10. Dressman, J. B., & Reppas, C. (2016). Oral Drug Absorption: Prediction and Assessment, Second Edition: CRC Press.
11. Ducharme, M. P., Shargel, L., & Yu, A. B. C. (2022). S*hargel and Yu's Applied Biopharmaceutics & Pharmaco kinetics, 8th Edition:* McGraw Hill LLC.
12. Jambhekar, S. S., & Breen, P. J. (2024). *Basic Pharmacokinetics:* Pharmaceutical Press.
13. Krishna, R., & Yu, L. (2010). Biopharmaceutics Applications in Drug Development: Springer US.
14. Mukherjee, B. (2022). *Pharmacokinetics: Basics to Applications*: Springer Nature Singapore.
15. Niazi, S. K. (2014). Handbook of Bioequivalence Testing, Second Edition: Taylor & Francis.
16. Rosenbaum, S. E. (2016). *Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer Simulations:* Wiley.
17. Sarmento, B., Pereira, C. L., & Das Neves, J. (2024). Concepts and Models for Drug Permeability Studies: Cell and Tissue based In Vitro Culture Models: Woodhead Publishing.
18. Steffansen, B., Brodin, B., & Nielsen, C. U. (2010). Molecular Biopharmaceutics: Aspects of Drug Characteri sation, Drug Delivery and Dosage Form Evaluation: Pharmaceutical Press.
19. Sugano, K. (2012). *Biopharmaceutics Modeling and Simulations: Theory, Practice, Methods, and Applitions:* Wiley.
20. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
21. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
22. Washington, N., Washington, C., & Wilson, C. (2000). Physiological Pharmaceutics: Barriers to Drug Absorption: Taylor & Francis.

PHT-608 | Cr. Hrs. 1

Biopharmaceutics and Pharmacokinetics (Lab) - II

Course Learning Outcomes

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

1. Analyze the pharmacokinetic behavior of drugs administered via different routes and under various pathological conditions.

Contents

1. Pharmacokinetic Parameter Computation: Compute pharmacokinetic parameters using simulated pharmacokinetic models.
2. Bioanalytical Method Development: Demonstration and understanding of bioanalytical methods for the quantification of drugs in biological matrices using High-Performance Liquid Chromatography (HPLC).
3. Bioavailability Calculations: Calculate the bioavailability (F) of drugs and compare Area Under the Curve (AUC_0-∞) for oral versus intravenous administration using published data.
4. Determination of Biological Half Life: Zero order and first order half-life.
5. Bioequivalence Studies: Demonstration of Bioequivalence Assessment and determination of various parameters based on ICH/FDA guidelines.
6. Computational Pharmacokinetics: Utilize in-silico and computational methods to calculate compartmental, non-compartmental, Physiologically Based Pharmacokinetic (PBPK), and population pharmacokinetic parameters using various software tools such as PK-Sim, Phoenix WinNonlin, Monolix, Simcyp, and NONMEM.

Recommended Reading

1. Adejare, A. (2020). Remington: The Science and Practice of Pharmacy: Academic Press.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). *Integrated Pharmaceutics: Applied Preformulation, Product Design, and Regulatory Science:* Wiley.
3. Banakar, U. V. (2021). Pharmaceutical Dissolution Testing, Bioavailability, and Bioequivalence: Science, Applications, and Beyond: Wiley.
4. Batchelor, H. (2021). *Biopharmaceutics: From Fundamentals to Practice:* Wiley.
5. Berner, B., Gordi, T., Benson, H. A. E., & Roberts, M. S. (2021). *Drug Delivery Approaches: Perspectives from Pharmacokinetics and Pharmacodynamics:* Wiley.
6. Boroujerdi, M. (2015). *Pharmacokinetics and Toxicokinetics:* Taylor & Francis.
7. Chow, S. C., & Liu, J. (2009). Design and Analysis of Bioavailability and Bioequivalence Studies: CRC Press.
8. Curry, S. H., & Whelpton, R. (2022). *Drug Disposition and Pharmacokinetics: Principles and Applications for Medicine, Toxicology and Biotechnology:* Wiley.
9. Derendorf, H., & Schmidt, S. (2019). *Rowland and Tozer's Clinical Pharmacokinetics and Pharmacodynamics: Concepts and Applications:* Wolters Kluwer Health.
10. Dressman, J. B., & Reppas, C. (2016). Oral Drug Absorption: Prediction and Assessment, Second Edition: CRC Press.
11. Ducharme, M. P., *Shargel, L., & Yu, A. B. C. (2022). Shargel and Yu's Applied Biopharmaceutics & Pharmaco kinetics, 8th Edition:* McGraw Hill LLC.
12. Jambhekar, S. S., & Breen, P. J. (2024). *Basic Pharmacokinetics:* Pharmaceutical Press.
13. Krishna, R., & Yu, L. (2010). Biopharmaceutics Applications in Drug Development: Springer US.
14. Mukherjee, B. (2022). *Pharmacokinetics: Basics to Applications:* Springer Nature Singapore.
15. Niazi, S. K. (2014). Handbook of Bioequivalence Testing, Second Edition: Taylor & Francis.
16. Rosenbaum, S. E. (2016). *Basic Pharmacokinetics and Pharmacodynamics: An Integrated Textbook and Computer Simulations*: Wiley.
17. Sarmento, B., Pereira, C. L., & Das Neves, J. (2024). Concepts and Models for Drug Permeability Studies: Cell and Tissue based In Vitro Culture Models: Woodhead Publishing.
18. Steffansen, B., Brodin, B., & Nielsen, C. U. (2010). Molecular Biopharmaceutics: Aspects of Drug Characteri sation, Drug Delivery and Dosage Form Evaluation: Pharmaceutical Press.
19. Sugano, K. (2012). *Biopharmaceutics Modeling and Simulations: Theory, Practice, Methods, and Applitions:* Wiley.

20. Swarbrick, J. (2013). *Encyclopedia of Pharmaceutical Science and Technology, Fourth Edition, Six Volume Set (Print):* Taylor & Francis.
21. Taylor, K., & *Aulton, M. E. (2021). Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
22. Washington, N., Washington, C., & Wilson, C. (2000). Physiological Pharmaceutics: Barriers to Drug Absorption: Taylor & Francis.

PHT-702 | Cr. Hrs. 3

Pharmaceutical Technology - II

Course Learning Outcomes

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

1. Explain the development of biological, biotechnological, and biosimilar products.
2. Describe and demonstrate the emerging concepts and techniques in the development of novel drug delivery systems.

Contents

1. **Scope, Application, and New Findings in Pharmaceutical Biotechnology:**
   Innovations, research frontiers, development, and production techniques of products like Antibiotics, amino acids, insulin, enzymes, vaccines, etc.

2. **Role of Pharmaceutical Biotechnology in New Product Development (NPD):**
   How biotechnology influences drug development pipelines

3. **Gene Drug Delivery Systems:**
   Concepts, technologies, and applications in gene-based products (mRNA, siRNA etc., based vaccines and therapeutics. Development pipelines and future outlook).

4. **Biosimilars and Biobetters:**
   Introduction, regulatory perspectives, development challenges and business opportunities.

5. **Artificial Intelligence Applications in Biotechnology:**
   AI in biologics development, quality prediction, and bioprocess optimization.

6. **Monoclonal & Polyclonal antibodies:**
   Antibody structure, Development of antibody-based therapeutics, Methods of Production and characterization, Applications of monoclonal and polyclonal antibodies

Recommended Reading

1. Aebisher, D. (2020). *An Essential Guide to Biopharmaceuticals:* Nova Science Publishers, Incorporated.
2. Al-Achi, A., Gupta, M. R., & Stagner, W. C. (2022). I*ntegrated 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.
4. Altman, R. B., *Altman, R., Flockhart, D., & Goldstein, D. B. (2012). Principles of Pharmacogenetics and Pharmacogenomics:* Cambridge University Press.
5. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
6. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology: Fundamentals and Applications:* Springer International Publishing.
7. Curry, S. H., & Whelpton, R. (2022). *Drug Disposition and Pharmacokinetics: Principles and Applications for Medicine, Toxicology and Biotechnology:* Wiley.
8. Donnelly, R. F., & Singh, T. R. R. (2015). *Novel Delivery Systems for Transdermal and Intradermal Drug Delivery:* Wiley.
9. Donnelly, R. F., Singh, T. R. R., Morrow, D. I. J., & Woolfson, A. D. (2012). *Microneedle- mediated Transdermal*

and Intradermal Drug Delivery: Wiley.
10. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
11. Fahr, A., & Scherphof, G. L. (2018). *Voigt's Pharmaceutical Technology:* Wiley.
12. Florence, A. T., & Siepmann, J. (2016). *Modern Pharmaceutics, Two Volume Set:* CRC Press.
13. Ghosh, T. K. (2020). *Dermal Drug Delivery: From Innovation to Production:* CRC Press.
14. Gutka, H. J., Yang, H., & Kakar, S. (2018). *Biosimilars: Regulatory, Clinical, and Biopharmaceutical Devement:* Springer International Publishing.
15. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
16. Hillery, A., & Park, K. (2016). *Drug Delivery: Fundamentals and Applications, Second Edition:* CRC Press.
17. Ho, R. J. Y. (2013). *Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs*: Wiley.
18. Ita, K. (2020). Transdermal Drug Delivery: *Concepts and Application:* Academic Press.
19. Jameel, F., Hershenson, S., Khan, M. A., & Martin-Moe, S. (2016). *Quality by Design for Biopharmaceutical Drug Product Development:* Springer New York.
20. Liu, C., & Morrow, K. J. (2016). *Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical, and Clinical Development:* Wiley.
21. Pathak, Y. (2022). *Gene Delivery Systems: Development and Applications:* CRC Press.
22. Rathbone, M., Hadgraft, J., Roberts, M. S., & Lane, M. E. (2008). *Modified-Release Drug Delivery Technology:* CRC Press.
23. Rathore, A. S., Baseman, H., & Rudge, S. (2023). Process Validation in Manufacturing of Biopharmaceuticals: CRC Press.
24. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
25. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

PHT-704 | Cr. Hrs. 1

Pharmaceutical Technology (Lab) - II

Course Learning Outcomes

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

1. Explore the recent advancements in pharmaceutical technologies.
2. Describe and demonstrate the emerging concepts and techniques in the development of novel drug delivery systems.

Contents

1. **Development of transdermal patches:**
   Formulation of patches with suitable active pharmaceutical ingredients (APIs).

2. **Preparation of microemulsions**

3. **Preparation of dissolving microneedles:**
   Fabrication techniques for transdermal drug delivery.

4. **Development of fast dispersible tablets and gastroretentive floating tablets: Evaluation of buoyancy parameters.**

5. **Preparation and characterization of pharmaceutical hydrogels.**

6. **Molecular Biology and Biotechnology Techniques**
   a. Demonstration and understanding of the following techniques.
   b. Extraction of nucleic acids (DNA/RNA)
   c. Polymerase chain reaction (PCR)
   d. Gel electrophoresis (DNA/Protein)
   e. DNA quantification
   f. Sequencing techniques
   g. Antigen-antibody based reactions

Recommended Reading

1. Aebisher, D. (2020). *An Essential Guide to Biopharmaceuticals:* Nova Science Publishers, Incorporated.
2. 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.
4. Altman, R. B., Altman, R., Flockhart, D., & Goldstein, D. B. (2012). *Principles of Pharmacogenetics and Pharmacogenomics:* Cambridge University Press.
5. British Pharmacopeia Commission (2024). *British Pharmacopeia 2025*. Medicines and Healthcare Products Regulatory Agency.
6. Crommelin, D. J. A., Sindelar, R. D., & Meibohm, B. (2024). *Pharmaceutical Biotechnology: Fundamentals and Applications:* Springer International Publishing.
7. Curry, S. H., & Whelpton, R. (2022). *Drug Disposition and Pharmacokinetics: Principles and Applications for Medicine, Toxicology and Biotechnology:* Wiley.
8. Donnelly, R. F., & Singh, T. R. R. (2015). *Novel Delivery Systems for Transdermal and Intradermal Drug Delivery:* Wiley.
9. Donnelly, R. F., Singh, T. R. R., Morrow, D. I. J., & Woolfson, A. D. (2012). *Microneedle- mediated Transdermal and Intradermal Drug Delivery:* Wiley.
10. *European Pharmacopeia (11th edition).* European Directorate for the Quality of Medicines & Healthcare.
11. Fahr, A., & Scherphof, G. L. (2018). Voigt's *Pharmaceutical Technology:* Wiley.
12. Florence, A. T., & Siepmann, J. (2016). *Modern Pharmaceutics, Two Volume Set:* CRC Press.
13. Ghosh, T. K. (2020). *Dermal Drug Delivery: From Innovation to Production:* CRC Press.
14. Gutka, H. J., Yang, H., & Kakar, S. (2018). *Biosimilars: Regulatory, Clinical, and Biopharmaceutical Develop ment*: Springer International Publishing.
15. Haider, S. I., & Asif, E. S. (2012). *Quality Operations Procedures for Pharmaceutical, API, and Biotechnology:* Taylor & Francis.
16. Hillery, A., & Park, K. (2016). *Drug Delivery: Fundamentals and Applications, Second Edition:* CRC Press.
17. Ho, R. J. Y. (2013). *Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs*: Wiley.
18. Ita, K. (2020). *Transdermal Drug Delivery: Concepts and Application:* Academic Press.
19. Jameel, F., Hershenson, S., Khan, M. A., & Martin-Moe, S. (2016). *Quality by Design for Biopharmaceutical Drug Product Development:* Springer New York.
20. Liu, C., & Morrow, K. J. (2016). *Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical, and Clinical Development:* Wiley.
21. Pathak, Y. (2022). *Gene Delivery Systems: Development and Applications:* CRC Press.
22. Rathbone, M., Hadgraft, J., Roberts, M. S., & Lane, M. E. (2008). *Modified-Release Drug Delivery Technology:* CRC Press.
23. Rathore, A. S., Baseman, H., & Rudge, S. (2023). Process Validation in Manufacturing of Biopharmaceuticals: CRC Press.
24. Taylor, K., & Aulton, M. E. (2021). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines:* Elsevier.
25. *United States Pharmacopeia-National Formulary* (USP-NF 2024). United States Pharmacopeial Convention

Courses Schedule
Pharm. D. (Deficiency) Program

1st Semester			2nd Semester		
Course NO.	**Title of Course**	**Cr. Hrs.**	**Course NO.**	**Title of Course**	**Cr. Hrs.**
PHT -513 (D)	Computer Application in Pharmacy	2	PHT-606 (D)	Clinical Pharmacokinetics	3
PHT -613 (D)	Pharmaceutical Technology	3	PHT-614 (D)	Pharmaceutical Technology (Lab)	3
	-	-	PHT-702 (D)	Clinical Pharmacy	3
	-	-	PHT-708 (D)	Pharmaceutical Quality Control and Assurance	2
Total **6 courses**, making **16 Credit hours** in one year					

Pharm. D. Deficiency Program Courses – Outline

First Semester

PHT-513(D) | Cr. Hrs. 2

Computer Application in Pharmacy (Practical)

1. **Introduction to Microsoft Windows and its Different Packages Like MS Word, Excel, PowerPoint and Access**

2. **Internet and Email**
   Internet and microsoft internet explorer 5, searching the internet E-mail and News group. Favourites, security and customizing explorer.

3. **Web Page Development**
   Introduction to frontpage, creating a first Website, basic formatting technique, manipulating tables within frontpage, frontpage, pictures and multimedia, hyperlinking, bookmarks and image maps, Frontpage and frames. Managing your web, good site design

4. **Complete Statistical Packages, Statistica®**
   Languages, at Least Two Prevailing Languages Will be Taught

Recommended Reading

1. Lambert, J., & Frye, C. (2022). *Microsoft Office step by step (Office 2021 and Microsoft 365)* (1st ed.). Micro soft Press.
2. Lambert, J. (2022). *Microsoft Excel step by step (Office 2021 and Microsoft 365).* (1st ed.). Microsoft Press.
3. Gralla, P. (2006). *How the internet works* (8th ed.). Que Publishing.
4. Robbins, J. N. (2018). *Learning web design: A beginner's guide to HTML, CSS, JavaScript, and web graphics (5th ed.).* O'Reilly Media.
5. Columbus, L. (2008). *The MS-Windows XP Professional Handbook* (1st ed.). Laxmi Publications Pvt Limited.
6. TIBCO Software Inc. (2024). *TIBCO Statistica: User's guide*. TIBCO Software. https://docs.tibco.com
7. TIBCO Software Inc. (2024). *Electronic statistics textbook*. TIBCO Software. https://www.statsoft.com/textbook/
8. Herrera, C., & Hajek, D. W. (2023). *Introduction to Computers* (2023 ed.) Independently Published.

PHT-613(D) | Cr. Hrs. 3

Pharmaceutical Technology

1. **Principles of Pharmaceutical Formulation and Dosage Form Design, Product formulation, need for dosage form, pre-formulation studies.**

2. **Formulation Development**
   Pharmaceutical aerosols, ophthalmic preparations, parenteral preparations.

3. **Advanced Formulation Techniques**
   Development of a formulation methodology and flow plan for the new product. New technologies in drug delivery system.

4. **Pharmaceutical Biotechnology**
   Biotechnological aspects in the product development. Fundamentals of genetic engineering and its application in medicine. Principle, synthesis and application of monoclonal antibodies, introduction to Gene therapy. Immmobilized enzymes and their application in medicine. Production of biotech compounds, biotech vaccines, dispensing of biotech compounds.

5. **Novel Drug Delivery Systems**
   Introduction to the drug carrier, liposomcs as a drug carrier, niosomes as a drug carrier, biodegrad able polymers as a drug carrier, active and passive drug delivery system, other novel GIT systems, novel topical drug delivery systems.

6. **Modified Drug Release Dosage Form**
   The concept of sustained release, first order release approximation, multiple dosing, implementation of designing, approaches based upon dosage form modification. Product evaluation and testing, matrices tablets, control release technology. Microencapsulation, method of particle coating, instrumentation in granule manufacturing.

Recommended Reading

1. Banker, G. S. (2002). *Modern pharmaceutics* (4th ed.). Marcel Dekker Publishing.
2. Chein, Y. W. (2004). *Novel drug delivery system*. Marcel Dekker Publishing.
3. Crommelin, D. J. A., & Sindelar, R. D. (2002). *Pharmaceutical biotechnology*. Taylor & Francis.

Pharm. D. Deficiency Program Courses – Outline
Second Semester

PHT-606 (D) | Cr.Hrs.3

Clinical Pharmacokinetics

1. **Compartment Models:**
   One compartment model. Two compartment models. Three compartment models. Non- compart mental models.
2. **Biological Half-Life in Vitamin**
3. **Clearance, Evaluation**
4. **Protein Binding**
5. **Multiple Dosing Regimens**
6. **Application of Pharmacokinetics in Clinical Situation**
7. **Application in Dosage Sites**
8. **Bioavailability and Bioequivalence Testing**
9. **Pharmacokinetics of Intravenous Infusion**
10. **Non-Linear Pharmacokinetics**

Recommended Reading

1. Gibaldi, M. (1991). *Biopharmaceutics and clinical pharmacokinetics* (4th ed.). Lea & Febiger.
2. Schoenwald, R. D. (2000). *Pharmacokinetics: Principles of dosing adjustment*. CRC Press.
3. Shargel, L. (2002). *Biopharmaceutics and pharmacokinetics* (4th ed.). McGraw-Hill.

PHT-614 (D) | Cr.Hrs.3

Pharmaceutical Technology (Practical)

1. Blood sampling techniques in laboratory animals like dog, rabbits, mice etc. in human-beings.
2. Plasma level time curve determination of pharmacokinetic parameters
3. In-vitro dissolution studies
4. Optional dose determination.
5. Measurement of rate of bioavailability.
6. Determination of plasma protein binding.
7. Determination of relative and absolute bioavailability.
8. Urinary sampling techniques.
9. In laboratory animals. In humans, renal excretion of drugs or drug disposition.
10. Various techniques to develop the controlled release formulation
11. Biotechnological aspects of product development
12. Coating of particles
13. To prepare, examine and control specifications of packaging materials

Recommended Reading

1. Banker, G. S. (2002). *Modern pharmaceutics* (4th ed.). Marcel Dekker Publishing.
2. Crommelin, D. J. A., & Sindelar, R. D. (2002). *Pharmaceutical biotechnology*. Taylor & Francis.
3. Hellery, A. M., & Lloyd, A. W. (2001). *Drug delivery and targeting: For pharmacists and pharmaceutical s cientists*. Taylor & Francis.
4. Jain, N. K. (1997). *Controlled and novel drug delivery* (1st ed.). CBS Publishers & Distributors.
5. Ramabhadran, T. V. (1994). *Pharmaceutical design and development: A molecular biology approach* (1st ed.). CRC Press.

PHT-702(D) | Cr.Hrs.3

Clinical Pharmacy

1. Rational Use of Drugs
2. Rational prescribing, rational dispensing, problems of irrational drug use, learning about drug use problem, sampling to study drug use, indicators of drug use.
3. Introduction to Essential Drugs
4. Criteria for selection, use, advantages.
5. Drug Utilization evaluation & Drug Utilization Review (DUE/PUR)
6. Development of protocol of use of low very low therapeutic index drugs (Steroids, Vancomycin, Cimetidine etc.).
7. Drug abuse and misuse. Drug induced modification of lab test values and drug induced diseases.
8. Practical Pharmacokinetics
9. Therapeutic drug monitoring of the narrow therapeutic range drugs and other essential drugs.
10. Pharmacoeconomic studies
11. Pharmaceutical care its scope, management and application of care plan.
12. Role of clinical pharmacist in community pharmacy.
13. Save intravenous therapy and hazards of intravenous therapy
14. Non-compliance: Definition, introduction and importance. Extent of non-compliance. Methods of assessment. Reasons for non-compliance. Strategies for improving compliance.

15. Designing of compliance trials.
16. Patient Counseling
17. Patient Profile: Patient disease profile, taking case history, drug profile of 25 drugs.
18. Adrenaline, aminoglycosides, anti TB drugs, antiepileptics, atropine, benzodiazepines, cepahlospo rins, chlorpheniramine, cimetidine, digoxin, dobutamine, dopamine, fluroquinolone, frusemide, lactulose, macrolides, metoclopramide, morphine/pethedine, nifedipine, NSAIDS. ORS, penicillins, prednisolone, salbutamol, vancomycin,
19. Utilization of clinical drug literature: Introduction. Drug literature selection. Drug literature evalua tion. Drug literature communication withdrawal, detection, reporting and management of ADR.
20. Computers in clinical pharmacy:
21. Role of Pharmacist in clinical trials of drug substances.
22. Designing of clinical trials. Types or trials. Choice of patients. Exclusion of patients. Monitoring a clinical trial.
23. Drug Interactions and Adverse Drug Reactions
24. Drug Interactions: Mechanism, physiological factors affecting interaction. Types and level of drug interactions. Role of pharmacist in evaluating drug interactions and its management.
25. Adverse drug reactions and side effects: Classification, Excessive pharmacological response. Idiosyn crasy, secondary pharmacological effects. Allergic drug reactions, General toxicity, toxicity following drug.

Recommended Reading

1. Aulton, M. E. (2000). *Pharmaceutical practice*. *Prentice* Hall Publishing.
2. DiPiro, J. T. (Ed.). (2002). *Encyclopedia of pharmacy*. Marcel Dekker Publishing.
3. Rantucci, M. J. (1997). *Pharmacists talking with patients: A guide to patient counseling*. Lippincott Williams & Wilkins.
4. Adejare, A. (Ed.). (2020). *Remington: The science and practice of pharmacy* (23rd ed.). Academic Press. https://doi.org/10.1016/C2018-0-02594-0

PHT-708(D) | Cr.Hrs.2

Pharmaceutical Technology (Practical)

1. **Good Manufacturing Practices for Pharmaceuticals**
   Control of components and drug product containers and doses. Production and process controls. Packaging and labelling controls. Holding and distribution. Repackaging and re-labelling.

2. **Validation of Pharmaceutical Process**
   Regulating basis for person validation, sterilization validation of sterile products. Sterile product validation. Validation of solid dosage form., Process validation and quality assurance. Prospective process validation, validation for water system for sterile and non-sterile products, cleaning valida tion, equipment validation, process validation of law materials. Analytical method validation, computer system validation, validation of diluted aerosole

3. **Different tests of liquids, emulsion, Solid state and Time Release Product**
   Biological assays, biological methods, bioassay of antibiotics. Standard preparation and unit of activity. Assay of vitamins, hormones.

4. **Miscellaneous Tests**
   Toxicity tests and identification test, ash contents etc. general knowledge of B.P, B.P.C. USP, N. etc. Statistical interpretation of quality controls data, quality control and 5.5.

5. **Quality Assurance of Hospital and Clinical Pharmacy**

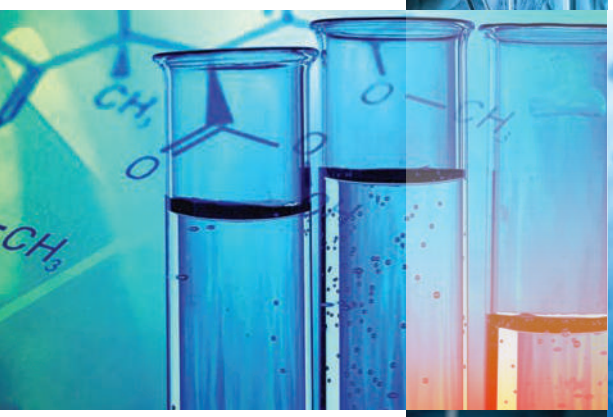
Recommended Reading

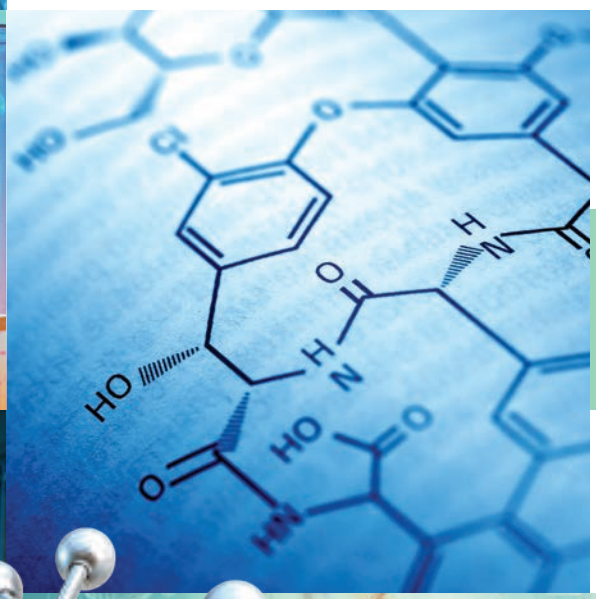
1. DiPiro, J. T. (Ed.). (2003). *Encyclopedia of clinical pharmacy*. Marcel Dekker Publishing.
2. Nash, R. A., & Wachter, A. H. (Eds.). (2005). *Pharmaceutical process validation* (3rd ed.). Marcel Dekker Publishing.
3. Willig, S. H. (2000). *Good manufacturing practices for pharmaceuticals*. Marcel Dekker Publishing.

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Department of

Pharmaceutical Chemistry





Message

The Chairperson, Department of Pharmaceutical Chemistry

My Dear Students,

It is my pleasure to welcome you to the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, one of the most prestigious and respected institutions for pharmaceutical education in Pakistan. Choosing to pursue a Pharm. D. program here means joining a community that is deeply committed to academic excellence, professional integrity, and meaningful contribution to healthcare.

Our department takes pride in nurturing curious minds, fostering critical thinking, and preparing students to meet the new challenges of the pharmaceutical world. This admission catalogue has been carefully prepared to provide you with all essential information about our program, facilities, policies, and academic environment. I encourage you to explore it thoroughly as you embark on this exciting journey.

We are looking forward to support you as you grow into competent, compassionate, and future-ready pharmacy professionals.

Wishing you a bright future

Prof. Dr. Asia Naz Awan

Chairpers

Department of Pharmaceutical Chemistry

The Department of Pharmaceutical Chemistry was established in 1973 as independent unit of the Faculty of Pharmacy and since then performing its dynamic and active role in pharmacy education and research. The department offers Pharm. D., M.Phil. and Ph.D. courses. The undergraduate program of the department is dedicated to educate and train the students to produce active, skilled and responsible future pharmacist for academia, industry, hospitals and government and other health care setups. Courses offered by the department are based on organic, physical, analytical, instrumental and medicinal chemistry revolving around drug discovery and development. The curriculum also focuses on laboratory experience supported by an excellent teaching and infrastructure. Department comprised of two separate large buildings having spacious classrooms and well-equipped lab facilities.

The department currently boasts a dedicated faculty comprising seven professors and three assistant professors, all actively engaged in both teaching and research. Over the past five decades, the department has been privileged to have numerous eminent and senior professors, including four, who have served as Dean of the Faculty. It is a great honor that distinguished scientists and scholars such as Prof. Emeritus Dr. Z. S. Saify (former Dean, Faculty of Pharmacy, and Vice Chancellor, University of Karachi) and Prof. Dr. Iqbal Ahmed (Sitara-e-Imtiaz) have been associated with the department, contributing over fifty years of invaluable service

The department has a rich history of excellence in research and until now more than two hundred M.Pharm., M.Phil., and Ph.D. research scholars have been produced. Additionally, several hundred research papers have been published in renowned academic journals. The department offers dynamic and diverse research disciplines, including the synthesis of biologically active lead molecules, computer-aided drug design, photochemistry, natural product chemistry, stability testing, method development, and the medical applications of nanotechnology (nanomedicines).

The department not only believes but also striving to provide standard education to improve knowledge and skills with professional and personal grooming of the future Pharmacists.

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website: **https://www.uok.edu.pk/faculties/pharmaceuticalchemistry/index.php**

Department of **Pharmaceutical Chemistry**

Vision

To embark upon a consistent intellectual and scientific journey with a aim of providing high quality education and research opportunities.

Mission

To nurture the capabilities and potential of all knowledge seekers in a highly inspiring and academic environment fostering critical thinking and leadership qualities in the field of Pharmaceutical Sciences.

Dr. Asia Naz

Chairperson and Professor

Qualification
Post Doc (USA) Ph.D., B.Pharm. (University of Karachi)

Year of Association
2012

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Dr. Asia Naz Awan received her Ph.D. in Pharmaceutical Chemistry from the Faculty of Pharmaceutical Sciences, University of Karachi in 2009 and Post-doctorate from Bindley Bioscience, Purdue University (USA) in Nanotechnology in 2013. The basis of her work stems from a multidisciplinary background and skills developed in the field of analytical chemistry, medicinal chemistry, bio nanotechnology and drug delivery. She is a Professor at the Department of Pharmaceutical Chemistry. Her research group extensively published in biosensors, drug enzyme interaction kinetics and drug dynamics, in silico studies and nanotechnology applied to human health. They are interested in developing smart therapeutics drug delivery for AMR, Alzheimer, cancer and immunotherapy. She has been awarded for Best University Teacher Award 2010 by HEC Pakistan. She won Best Research Paper Award of 2015/2016 in the field of Pharmacy by HEC. Additionally, she is working as Co-patron of Pharmacy scientific club, focal person of ORIC & QC, member of Faculty Board of Studies, and Departmental Board of Studies.

Dr. Nousheen Mushtaq

Professor

Qualification
Ph.D. M.Phil. B.Pharm.
(University of Karachi)

Year of Association
2002

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Dr. Nousheen Mushtaq has nearly three decades of experience as a dedicated educator and researcher in the Department of Pharmaceutical Chemistry. She is deeply committed to inspiring students to grasp and apply key concepts and strategies within the field. Beyond the classroom, she has contributed to curriculum design, participated and organized national and international training programs and learning courses. She has also been actively involved in co-curricular initiatives aimed at enhancing student growth and development.

Dr. Nousheen is an experienced researcher with numerous publications focusing on computer-aided drug design. She specializes in targeted synthesis of bioactive compounds focusing on pain, depression, and neurodegenerative diseases. She has held multiple academic positions and administrative responsibilities and serves on professional boards and editorial committees, demonstrating her commitment to continuous learning and professional development.

Dr. Sohail Hassan

Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2006

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Dr. Sohail Hassan is a Professor in the Department of Pharmaceutical Chemistry, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, has made significant contributions to the field of pharmaceutical sciences. He received his Ph.D. in 2003 and began his academic career as an Assistant Professor in the Department of Pharmaceutical Chemistry, in 2006 advancing to Associate Professor in 2016 and Professor in 2023. He served as Chairman of the department from 2021 to 2024 fostering, its academic and administrative growth.

Dr. Sohail's areas of interest include analytical and medicinal chemistry. He has published over 40 research articles in HEC-recognized international journals. He has supervised 1 Ph.D. and 20 M.Phil. students, with 10 Ph.D. and 8 M.Phil. students currently under his guidance. Aa an active member of the University's Senate, Academic Council, Board of Faculty, Board of Studies, and various university committees, Dr. Sohail continues to shape the future of pharmaceutical education and research.

Dr. Safila Naveed

Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2023

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Dr. Safila Naveed is a Professor in the Department of Pharmaceutical Chemistry, Faculty of Pharmacy, University of Karachi. She holds a Ph.D. and M.Phil. in Pharmaceutical Chemistry from the University of Karachi. She had been associated with Jinnah University for Women from 2011-2023. She has held several key academic and administrative positions, including Dean Research and Dean Faculty of Pharmacy at Jinnah University for Women, Karachi (2020-2023), where she played a pivotal role in advancing research and academic standards. Prior, she was associated with Hamdard University (2005-2011). In addition to academia, she has practical experience in hospital and pharmaceutical industry settings (2002-2004).

Her research interests include drug interactions, assay method development, phytochemistry, and formulation of new agents. With over 20 years of experience in academia she has supervised more than 40 M.Phil. and Ph.D. students contributing significantly to the field through her extensive research. Her dedication to teaching, research, and mentorship has significantly contributed to the advancement of pharmaceutical sciences in Pakistan.

Dr. Shazia Haider

Assistant Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2012

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Dr. Shazia Haider is an esteemed academic and researcher. Teaching is approached with great enthusiasm with the goal of inspiring and engaging students throughout their academic journey. She also facilitates students' activities to build confidence and enhance problem-solving, critical thinking, and communication skills, preparing them for real-world challenges. She has made significant contributions to medicinal chemistry by exploring innovative approaches for drug design and sustainable synthesis. Her research expertise lies in nitrogen substituted organic synthesis, with a focus on their therapeutic applications. She is also proficient in nanofabrication techniques to enhance drug delivery systems as well as in molecular docking studies to predict and optimize drug-target interactions. She has mentored number of M.Phil. and Ph.D. scholars, fostering the growth of future scientists. Her research projects are supported by prestigious grants from PSF and HEC. Her teaching and research reflecting her commitment to advancing in the field of Pharmaceutical Sciences.

Dr. Rubina Siddiqui

Assistant Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2012

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Dr. Rubina Siddiqui is a dedicated academic and researcher, currently serving as an Assistant Professor in the Department of Pharmaceutical Chemistry at the University of Karachi. Teaching is considered a passion for her, with a strong emphasis placed on educating students across various courses. The objective extends beyond knowledge transfer to foster the development of strong character traits in students.

Research efforts have been focused on two primary areas. During M.Phil. studies, interaction studies were conducted on anti-hypertensive drugs with NSAIDs, exploring their binding properties and implications.

In Ph.D. research, a series of complex compounds were synthesized using simple chemicals, showing potential as anti-inflammatory agents. The work involved the design, synthesis, and characterization of these compounds, offering new insights into their therapeutic applications. She has demonstrated outstanding administrative skills in managing departmental activities and developing academic programs, thereby enriching the research and educational environment.

Dr. Urooj Nazim

Assistant Professor

Qualification
Ph.D.
(University of Karachi)
M.Phil., Pharm.D.
(Baqai Medical University)

Year of Association
2012

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Dr. Urooj Nazim, is an Assistant Professor in the Department of Pharmaceutical Chemistry at the Faculty of Pharmacy. She received her Pharm.D. and M.Phil. degrees from Baqai Institute of Pharmaceutical Sciences, Baqai Medical University in 2005 and 2010, respectively. She then completed her Ph.D. from the department of Pharmaceutical Chemistry, university of Karachi in 2019 in collaboration with HEJ research institute.

Her teaching expertise spans a broad range of subjects within pharmaceutical chemistry including organic chemistry, physical chemistry and medicinal chemistry. Over 19 years of teaching experience in pharmaceutical chemistry, she has developed and delivered various undergraduate and post graduate courses.

Her research focuses on designing and synthesizing novel pharmaceutical agents and exploring their potential therapeutic applications. She has published various research articles in reputable and high impact factor international and national journals including International Journal of Biochemistry and Cell Biology, Current Problems in Cardiology, Frontiers in oncology, Indian Journal of Pharmaceutical Sciences and Pakistan Journal of Pharmaceutical Sciences.

Board of Studies

Dr. Asia Naz
Professor and Chairperson
Department of Pharmaceutical Chemistry
University of Karachi, Karachi

Dr. Nousheen Mushtaq
Professor
Department of Pharmaceutical Chemistry
University of Karachi, Karachi

Dr. Sohail Hassan
Professor
Department of Pharmaceutical Chemistry
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Dr. Safila Naveed
Professor
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Dr. Urooj Nazim
Assistant Professor
Department of Pharmaceutical Chemistry
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Dr. Shamim Akhtar
Professor and Dean
Faculty of Pharmacy
Hamdard University, Karachi

Dr. Fahim Ahmed Siddiqui
Plant Head
Bosch Pharmaceutical (Pvt.) Ltd
Karachi

Dr. Moona Mehboob
Associate Professor and Chairperson
Department of Pharmaceutical Chemistry
College of Pharmacy
DOW University of Health Sciences, Karachi

Dr. Tania Mirza
Associate Professor and Chairperson
Department of Pharmaceutical Chemistry
Baqai Medical University, Karachi

Pharm. D. Courses
First Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHC-305	Organic Chemistry - I	3	Core
PHC-307	Organic Chemistry (Lab) - I	1	Core
PHC-309	Biochemistry - I	2	Core
PHC-311	Biochemistry (Lab) - I	1	Core
Third Professional			
PHC-501	Pharmaceutical Analysis - I	3	Core
PHC-503	Pharmaceutical Analysis (Lab) - I	1	Core
PHC-515	Quantitative Reasoning - I {Maths}	3	General Edu.
Fifth Professional			
PHC-707	Medicinal Chemistry - I	3	Core
PHC-709	Medicinal Chemistry (Lab) - I	1	Core

Pharm. D. Courses
Second Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHC-306	Organic Chemistry - II	3	Core
PHC-308	Organic Chemistry (Lab) - II	1	Core
PHC-310	Biochemistry - II	2	Core
PHC-312	Biochemistry (Lab) - II	1	Core
Third Professional			
PHC-502	Pharmaceutical Analysis - II	3	Core
PHC-504	Pharmaceutical Analysis (Lab) - II	1	Core
PHC-520	Quantitative Reasoning - II {Biostats}	3	General Edu.
Fourth Professional			
PHC-610	Pharmaceutical Quality Control	2	Core
PHC-612	Pharmaceutical Quality Control (Lab)	1	Core
Fifth Professional			
PHC-706	Medicinal Chemistry - II	3	Core
PHC-708	Medicinal Chemistry (Lab) - II	1	Core
Total **20 Courses** worth **39 Credit Hours** in five years			

Pharm. D. Courses – Outline
First Semester

PHC-305 | Cr. Hrs. 3

Organic Chemistry-I

Course Learning Outcomes

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

1. Understand organic chemistry concepts such as bonding, hybridization, and reactivity, with a focus on pharmaceuticals.
2. Analyze organic reactions like oxidation, reduction, and substitution, focusing on pharmaceutical applications.
3. Understand the concept of stereochemistry and its application in pharmacy.

Contents

The following topics will be taught with special reference to their Pharmaceutical Applications.

1. **Basic concepts**
   Chemical Bonding and concept of Hybridization, Conjugation, Resonance, Hyperconjugation, Aromaticity, Electronegativity, Dipole Moment, Inductive effect, Mesomeric Effect, Electrometric effect, Hydrogen bonding, Steric effect, and Tautomerism (keto-enol in tetracyclines and lactam-lactim).

2. **Synthesis, structure, nomenclature, properties, and pharmaceutical applications of functional organic compounds in drugs synthesis:**
   Alkane, Alkenes, Alkynes, Alcohol, phenols, ethers, amines, Ketones, Aldehydes, Carboxylic Acids, Esters, Amides, Alkyl halide, and Aromatic compounds.

3. **Types of reactions in aliphatic and aromatic systems and their applications:**
   Organic Reactions Mechanism: Oxidation, Reduction, Acylation, Esterification, and Nucleophilic Substitution reactions (SN1, SN2). Elimination Reactions, Addition Reactions, Rearrangement, and Polymerization Reactions.

4. **Stereochemistry:**
   Configurational analysis; Optical Isomerism and Chirality. Enantiomers and Diastereoisomers. D/L, R/S system of nomenclature. Geometrical Isomerism, (cis/trans, E/Z system). (comparison of Fischer, Newman, and Sawhorse Projections formulas). Resolution of racemic mixture. Conformational analysis (conformations in straight carbon chain and cyclic structures). Applications of stereochemistry in pharmacy

Recommended Reading

1. Brown, W. H., & Bursten, M. L. (2014). *Introduction to organic chemistry* (8th ed.). Wiley
2. Johnson, W. S. (2003). *Organic chemistry in the laboratory.* W. H. Freeman and Company.
3. Vollhardt, K. P. C., & Schore, N. E. (2014). *Organic chemistry: Structure and function* (7th ed.). W. H. Freeman and Company.
4. Thomas, G. (2013). Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.
5. Carey, F. A. (2007). *Advanced organic chemistry: Part A: Structure and mechanisms* (5th ed.). Wiley.
6. Prasad, N. D. V. G. S., & Shinde, S. C. (2009). *Pharmaceutical organic chemistry.* Pharma Book Syndicate.
7. Silverman, R. B. (2014). *The organic chemistry of drug design and drug action* (2nd ed.). Academic Press.
8. Lemke, T. L., & Williams, D. A. (2013). *Foye's principles of medicinal chemistry* (7th ed.). Lippincott Williams & Wilkins
9. Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley.

PHC-307 | Cr. Hrs. 1

Organic Chemistry (Lab)-I

Course Learning Outcomes

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

1. Synthesize and identify organic compounds for drug development, emphasizing nomenclature and reaction mechanisms.

Contents

1. Good laboratory practice for chemistry lab (Protocol for Handling of flammable, non-flammable solvents/compounds and other hazardous substances) and introduction to organic chemistry lab apparatus, and instruments.
2. Identify the functional group present in given organic compound by systemic 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 ester, 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 recrystallization (e.g. Benzoic acid/ salicylic acid).
6. Identification of various organic compounds (E.g. Oxalic acid, Tartaric acid, Salicylic acid, Phthalic acid, Benzoic acid, Cresol, Resorcinol, urea, thiourea).

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Johnson, W. S. (2003). *Organic chemistry in the laboratory*. W. H. Freeman and Company.
2. Brown, W. H., & Bursten, M. L. (2014). *Introduction to organic chemistry* (8th ed.). Wiley.
3. Vollhardt, K. P. C., & Schore, N. E. (2014). *Organic chemistry: Structure and function* (7th ed.). W. H. Freeman and Company.
4. Thomas, G. (2013). *Medicinal chemistry: A molecular and biochemical approach. Oxford University Press.*
5. *Carey,* F. A. (2007). *Advanced organic chemistry: Part A: Structure and mechanisms* (5th ed.). Wiley.
6. Prasad, N. D. V. G. S., & Shinde, S. C. (2009). *Pharmaceutical organic chemistry.* Pharma Book Syndicate.
7. Silverman, R. B. (2014). *The organic chemistry of drug design and drug action* (2nd ed.). Academic Press.

PHC-309 | Cr. Hrs. 2

Biochemistry-I

Course Learning Outcomes

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

1. Understand Pharmaceutical Biochemistry concepts and its role in pharmacy, including its medical and pharmaceutical applications.
2. Explain biochemical processes of carbohydrates, lipids, and focusing on metabolism, disorders, and pharmaceutical relevance.
3. Analyze the role of hormones, vitamins, and secondary messengers in metabolic regulation and their pharmaceutical applications.

Contents

1. **General introduction to Pharmaceutical Biochemistry:**
   Role of Pharmaceutical Biochemistry in the Pharmacy Profession.

2. **Biochemistry of Carbohydrates:**
   Define carbohydrates, classification, isomerism, optical activity, structural representation of sugar molecules, chemical properties of carbohydrates, pharmaceutical importance. Carbohydrate digestion, absorption, metabolism and excretion, glycolysis dysregulations, feeder pathways of glycolysis, pentose phosphate pathway dysregulations, glucuronate pathway, glycogenolysis, glycogenesis, gluconeogenesis, citric acid cycle and dysregulation, energetics of various metabolic processes of carbohydrates. Brief overview of carbohydrate metabolic disorders.

3. **Bioenergetics:**
   Principles of bioenergetics, Electron transport chain and oxidative phosphorylation and disorders, reactive oxygen species generation and scavenging.

4. **Biochemistry of Lipids:**
   Define lipids, classifications (based on reactivity of lipids and based on complexity of structure), essential fatty acids, omega-3 fatty acids, eicosanoids, reactions of fatty acids and lipids, pharmaceutical importance. Lipids digestion, absorption, metabolism and excretion, oxidation of saturated and unsaturated, odd and even number fatty acids and dysregulation, Biosynthesis of fatty acids and dysregulation, cholesterol synthesis and its dysregulation, biosynthesis of neutral lipids, ketone bodies, energetics of various metabolic processes of lipids. Brief overview of lipid metabolic disorders.

5. **Biochemistry of Vitamins:**
   Vitamins, classification, structures, metabolic functions, physiological role, natural and synthetic sources, deficiencies and toxicities, pharmacological interactions of vitamins with drugs, pharmaceutical importance of vitamins.

6. **Biochemistry of Hormones:**
   Hormones, chemical classification, pharmaceutical importance of hormones.

Recommended Reading

1. Lippincott Williams & Wilkins. (2020). *Lippincott's illustrated reviews: Biochemistry.* Lippincott Williams & Wilkins.
2. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). *Stryer's biochemistry* (8th ed.). W. H. Freeman and Company.
3. Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.
4. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7th ed.). W. H. Freeman and Company.
5. Devlin, T. M. (2016). *Textbook of biochemistry with clinical correlations* (8th ed.). Wiley-Liss.
6. Gout, A. M. (2019). *Biochemistry for the pharmaceutical sciences* (4th ed.). Wiley.
7. Berg, J. M., & Stryer, L. (2020). *Biochemistry* (9th ed.). W. H. Freeman and Company.
8. Hodges, R. S. (2019). *Biochemistry: A short course* (3rd ed.). Wiley.
9. Tortora, G. J., & Derrickson, B. H. (2020). *Principles of anatomy and physiology* (15th ed.). Wiley.
10. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science.
11. 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.

PHC-311 | Cr. Hrs. 1

Biochemistry (Lab) I

Course Learning Outcomes

After completion of this course the students will be able to:
Demonstrate proficiency in biochemical lab techniques, including analysis of biological samples and clinical chemistry tests with pharmaceutical focus.

Contents

Qualitative and Quantitative analysis of Carbohydrates (monosaccharides, disaccharides, reducing sugars) by following methods: Molisch's test, Benedict's test, Fehling's test, Salivanoff's test, Barfoed test, Iodine test, Osazone test, Bial Orcinol test, Anthrone Test) and lipids and Sterols (Cholesterol), Bile salts, Bilirubin, Analysis of Glucose, Cholesterol and Creatinine in Blood.

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). *Stryer's biochemistry* (8th ed.). W. H. Freeman and Company.
2. 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.
3. Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.
4. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7th ed.). W. H. Freeman and Company.
5. Devlin, T. M. (2016). *Textbook of biochemistry with clinical correlations* (8th ed.). Wiley-Liss.
6. Gout, A. M. (2019). *Biochemistry for the pharmaceutical sciences* (4th ed.). Wiley.
7. Berg, J. M., & Stryer, L. (2020). *Biochemistry* (9th ed.). W. H. Freeman and Company.
8. Hodges, R. S. (2019). *Biochemistry: A short course* (3rd ed.). Wiley.
9. Tortora, G. J., & Derrickson, B. H. (2020). *Principles of anatomy and physiology* (15th ed.). Wiley.
10. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science.
11. Lippincott Williams & Wilkins. (2020). *Lippincott's illustrated reviews: Biochemistry.* Lippincott Williams & Wilkins.

PHC-501 | Cr. Hrs. 3

Pharmaceutical Analysis I

Course Learning Outcomes

After completion of this course the students will be able to:

1. Understand the significance of each analytical technique in pharmaceutical quality control and regulatory compliance.
2. Interpret experimental results from different analytical techniques.
3. Demonstrate proficiency in applying chemical and instrumental methods of analysis for pharmaceutical compounds.

Contents

1. **Introduction to Pharmaceutical Analysis.**
   Definition, types, principle, objectives, errors and scope of pharmaceutical analysis.

2. **Titrimetric Methods:**
   Theory, principle, working and applications of the following titrimetric method of analysis.
   - 2.1. Acid Base Titration
   - 2.2. Redox Titration
   - 2.3. Non-aqueous Titration
   - 2.4. Complexometric Titration

3. **Electrochemical Methods:**
   Theory, principle, working and applications of the following electro chemical methods of analysis.
   - 3.1. Conductometry
   - 3.2. Potentiometry
   - 3.3. Polarography

4. **Thermal and Gravimetric Methods:**
   Theory, principle, working and applications of the following thermal and gravimetric method of analysis.
   - 4.1. Thermo gravimetric analysis (TGA)
   - 4.2. Differential Scanning Calorimetry (DSC)
   - 4.3. Differentials Thermal Analysis (DTA)

5. **Other Methods:**
   - 5.1. Karl Fischer titration
   - 5.2. Fluorimetry
   - 5.3. Polarimetry

Recommended Reading

1. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.
2. Golden W. Evings, (1985). Instrumental methods of chemical analysis (5th edition) Mc Graw Hill, London.
3. David G. Watson (2007). Pharmaceutical analysis, a text book for pharmacy students and pharmaceutical chemistry (2nd edition) Elsevier Churchill Livingston, UK.
4. Mendham J. Denney R.C, Barnes J.D, Thomas M and Sivasankar B (2011) vogels text book of quantitative chemical analysis (6th edition). Dorling Kindersley India.
5. Satinder Ahuja and Stephen Skypinski (2005). Hand book of modern pharmaceutical analysis academic press, California.
6. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
7. The International Pharmacopoeia (3rd edition) WHO. AITBS publisher, Kishan Noya Delhi.
8. United States Parmacopeial (2020). United States Parmacopeia and National Formulary (USP 43- NF 38). Rockville, MD: USP.British Parmacopeia Commission (2022). British Parmacopeia London: Stationary Office.

PHC-503 | Cr. Hrs. 1

Pharmaceutical Analysis (Lab) I

Course Learning Outcomes

After completion of this course the students will be able to:

1. Demonstrate proficiency in applying chemical and instrumental methods of analysis for pharmaceutical compounds.
2. Develop practical skills in performing pharmaceutical assays, determining compound concentrations, and evaluating purity.

Contents

To perform at least ten (10) practicals; one (1) from each method / technique

1. Acid-Base titration of a chemical substance used in Pharmaceuticals.
2. Non-Aqueous titration of different pharmaceutical compounds.
3. Complexometric titration of metal ion.
4. Redox titration of different pharmaceutical compounds.
5. Potentiometric determination of H_2SO_4.
6. Potentiometric determination of pH & concentration of a solution.
7. Potentiometric titration of strong acid and strong base.
8. Conductometric determination of different water samples for their quality assessment.
9. Conductometric determination of the solubility of sparingly soluble salt.
10. Conductometric determination of ionization constant of a weak Acid.
11. Conductometric titration of acids and bases.
12. Polarimetric determination of sugars, amino acid and other raw materials.
13. Polarographic determination of amount of nitrobenzene in solutions.
14. Determination of the concentration of APIs in solution by polarimetry
15. Fluorimetric determination of a standard drug in a given sample.

16. Determination of water content is pharmaceutical raw material / excipient using Karl Fischer titration method.

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.
2. Golden W. Evings, (1985). Instrumental methods of chemical analysis (5th edition) Mc Graw Hill, London.
3. David G. Watson (2007). Pharmaceutical analysis, a text book for pharmacy students and pharmaceutical chemistry (2nd edition) Elsevier Churchill Livingston, UK.
4. Mendham J. Denney R.C, Barnes J.D, Thomas M and Sivasankar B (2011) vogels text book of quantitative chemical analysis (6th edition). Dorling Kindersley India.
5. Satinder Ahuja and Stephen Skypinski (2005). Hand book of modern pharmaceutical analysis academic press, California.
6. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
7. The International Pharmacopoeia (3rd edition) WHO. AITBS publisher, Kishan Noya Delhi.
8. United States Parmacopeial (2020). United States Parmacopeia and National Formulary (USP 43- NF 38). Rockville, MD: USP.British Parmacopeia Commission (2022). British Parmacopeia London: Stationary Office.

PHC-515 | Cr. Hrs. 3

Quantitative Reasoning – I (Mathematics)

Course Learning Outcomes

After completion of this course the students will be able to:

1. Solve fundamental algebraic equations and sequences.
2. Apply basic trigonometric concepts and angle measurements.
3. Use coordinate geometry to work with points and simple curves.
4. Apply differentiation to analyze and optimize functions.
5. Use integration techniques to solve basic mathematical problems.

Contents

1. **Algebra**
   a. Solution of Linear and Quadratic Equations. Equations reducible to Quadratic Form. Solution of simultaneous Equations.
   b. Arithmetic, Geometric and Harmonic Progressions: Arithmetic, Geometric and Harmonic Means.
   c. Permutations and Combinations:
   d. Binomial Theorem: Simple application.

2. **Trigonometry**
   Measurement of angles in Radian and Degrees. Definitions of circular functions. Derivation of circular function for simple cases.

3. **Analytical geometry**
   Coordinates of point in a plane. Distance between two points in a plane. Locus, Equations of straight line, Equation of Parabola, Circle and Ellips.

4. **Differential calculus**
   Functions, variations in functions, limits, differential coefficient, differentiation of algebraic, trigonometric, exponential and logarithmic functions, partial derivatives. Maxima and minima values. Points of inflexion.

5. **Integral calculus**
   Concept of integration Rules of integration. Integration of algebraic, exponential, logarithmic and trigonometric functions by using different techniques, and numerical integration

Recommended Reading

1. Bali N, Gupta P, Gandhi C. A Textbook of Pharmaceutical Mathematics. 2nd Ed. Laxmi Publications; 2008.
2. Edvards CH, Penney DE. Calculus and Analytic Geometry. 5th Ed. Prentice Hall Inc; 1999.
3. Hoel PG, PortSC, Stone CJ. Introduction to Statistical Theory. 1st Ed. Brooks Cole; 1972.

PHC-707 | Cr. Hrs. 3

Medicinal Chemistry I

Course Learning Outcomes

After completion of this course the students will be able to:

1. Explain key concepts of drug discovery and design, including SAR, QSAR, and Lipinski's Rule of Five.
2. Apply physicochemical principles to improve drug properties like solubility, lipophilicity, and bioavailability.
3. Analyze the chemical structures, SAR, and therapeutic roles of CNS drugs, analgesics, hormones and anticancer agents relevant to diseases prevalent in Pakistan.

Contents

1. **Brief Introduction, history and development of medicinal chemistry.**
2. **Introduction to Drug Design and Development:**Lead Compounds (Hit to Lead modification): Pharmacokinetic and Pharmacodynamic Factors influencing drug design and development
3. **Prodrugs and Bioisosters:** General description and its pharmaceutical applications.
4. **In-silico Drug Design Approaches:** Structure-Based Drug Design (SBDD) and Ligand-Based Drug Design (LBDD). Prediction of "drug likeness" Lipinski's Rule of 5,
5. **Structure-Activity Relationship (SAR) & Quantitative SAR (QSAR).**
6. **Combinatorial Chemistry and High-Throughput Screening (HTS).**
7. **Drug Repurposing.**

General properties, Chemistry, SAR, Biological action and therapeutic uses of the following:

1. **Anesthetics**
   i. Local Anesthetics: Ester and amide derivatives (Procaine, Benzocaine and Lidocaine)
   ii. General Anesthetics: Inhalational (Halothane, Methoxyflurane Nitrous oxide sevoflurane, isoflurane, desflurane) and intravenous (Thioamylal, Thiopental and Ketamine) anesthetics.

2. **Sedatives & Hypnotics:**
   Benzodiazepines (Diazepam and related analogues), Non-Benzodiazepines (Zolpidem) and Barbiturates (Phenobarbital and related analogues).

3. **Analgesics and Antipyretics**
   i. NSAIDs: Salicylates (aspirin, soluble aspirin and phenyl salicylate), p-aminophenol derivatives (Phenacetin and Paracetamol), and Pyrazolone and Pyrazolodione derivatives (Antipyrine), N-aryl anthranilic acid (Mefanemic acid and Mechlofenamic acid) and Arylacetic Acids derivatives (Ibuprofen and Diclofenac sodium/potassium). COX-2 inhibitors like celecoxib, etoricoxib, meloxicam
   ii. Narcotic Analgesics: Morphine and related analogues.

4. **Hormones and Related Agents**
   i. Sex Hormones & Modulators: Androgens e.g. Testosterone, Nandrolone, Estrogens e.g. Estradiol, Diethylstilbestrol, Progestins e.g. Progesterone, Levonorgestrel.
   ii. Corticosteroids: Glucocorticoids (Prednisolone, Dexamethasone)
   iii. Thyroid Drugs: L-Thyroxine, Anti-Thyroid Agents (Propylthiouracil)

5. **Antineoplastic Agents:**
   Alkylating agents, Anti metabolites, Antibiotics, antimitotic agents, Hormones and natural products.

Recommended Reading

1. Wermuth, C. G., & Livi, G. P. (2019). Chemistry of Drug Design and Drug Action (4th ed.). Academic Press.
2. Silverman, R. B., & Holladay, M. W. (2020). The Organic Chemistry of Drug Design and Drug Action
3. (3rd ed.). Academic Press.
4. Foye, W. O., Lemke, T. L., & Williams, D. A. (2020). Foye's Principles of Medicinal Chemistry (8th ed.). Lippincott Williams & Wilkins.
5. Hansch, C., & Fujita, T. (2020). Theoretical Drug Design: Volume I - Structure-Activity Relationships
5. Satinder Ahuja and Stephen Skypinski (2005). Hand book of modern pharmaceutical analysis academic press, California.
6. (2nd ed.). Springer.
7. Patel, M. (2018). Medicinal Chemistry: An Introduction (2nd ed.). Wiley-Blackwell.
8. Eger, E. I. (2020). Principles of Medicinal Chemistry (2nd ed.). Springer.

PHC-709 | Cr. Hrs. 1

Medicinal Chemistry (Lab) I

Course Learning Outcomes

After completion of this course the students will be able to:

1. Apply basic in-silico tools for drug design and discovery.
2. Carry out simple synthesis and characterization of pharmaceutical compounds using medicinal chemistry laboratory techniques.

Contents

NOTE: Practical of the subject shall be designed from time to time on the basis of the above mentioned theoretical topics and availability of the facilities.

1. **Dry Lab Practicals (In-Silico)**
   Structure drawing (2D & 3D) and reaction mechanisms using ChemDraw®; calculation of physicochemical properties such as logP, clogP, molar refractivity (MR), molecular weight, hydrogen bond donors and acceptors; drug-likeness screening using Lipinski's Rule of Five; prediction of drug properties via Swiss ADME and Molinspiration; protein structure modeling using Phyre2 and I-TASSER; basic docking studies using CB-Dock and PatchDock.

2. **Wet Lab Practicals**
   Estimation of functional groups (carboxylic, hydroxy, amino, nitro); determination of molecular weights of organic compounds; Synthesis of Paracetamol, Aspirin, Salicylic Acid, Methyl Salicylate, benzamide, benzanilide, benzyl benzoate, phenyl benzoate, Azobenzene, Benzoic Acid, 5-Hydroxy-1,3-benzoxazol-2-one, , p- Nitrosophenol, 3-Nitrophthalic Acid, o-Chlorobenzoic Acid; Assay of drugs such as Sulpha drugs, Aspirin, Paracetamol, Benzyl Penicillin, and selected inorganic preparations.
   (Note: A minimum of 10 practicals will be conducted).

Recommended Reading

1. Wermuth, C. G., & Livi, G. P. (2019). Chemistry of Drug Design and Drug Action (4th ed.). Academic Press.
2. Silverman, R. B., & Holladay, M. W. (2020). The Organic Chemistry of Drug Design and Drug Action
3. (3rd ed.). Academic Press.
4. Foye, W. O., Lemke, T. L., & Williams, D. A. (2020). Foye's Principles of Medicinal Chemistry (8th ed.). Lippincott Williams & Wilkins.
5. Hansch, C., & Fujita, T. (2020). Theoretical Drug Design: Volume I - Structure-Activity Relationships
6. (2nd ed.). Springer.
7. Patel, M. (2018). Medicinal Chemistry: An Introduction (2nd ed.). Wiley-Blackwell.
8. Eger, E. I. (2020). Principles of Medicinal Chemistry (2nd ed.). Springer.

Pharm. D. Courses – Outline
Second Semester

PHC-306 | Cr. Hrs. 3
Organic Chemistry-II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Describe the properties, preparation, , and pharmaceutical relevance of key heterocyclic compounds and fused ring systems.
2. Explain mechanisms involving reactive intermediates and named organic reactions with applications in drug synthesis.
3. Apply advanced organic synthesis methods including green chemistry and microwave-assisted synthesis in pharmaceutical compound development.

Contents

1. **Heterocyclic Chemistry:**
   Preparation and properties of medicinally important Heterocyclic Compounds such as pyrrole, furan, thiophene, pyridine, pyrimidine and pyrazine.
   Preparation and properties of heterocyclic compounds in which benzo-ring is fused with five and six membered rings containing one hetero atom; Indole, Quinoline and Isoquinoline. Additional Rings and Pharmaceuticals: imidazole (histamine, antifungals), purine/pyrimidine bases (DNA/RNA), benzoxazole, benzothiazole.

2. **Reaction Mechanisms and Reactive Intermediates:**
   An Overview of Reactive Intermediates: Carbocations, Carbanions, Carbenes, Nitrenes, Benzynes and Free Radicals and Free radical scavengers and their applications. Mechanism and applications of various reactions: Arndt-Eistert
   reaction, Baeyer-Villiger oxidation, Diels Alder reaction; Grignard's reaction, Metal Hydride reduction and Wolff Kishner reduction, Friedel Craft's reaction, Perkin reaction, Cannizzaro's reaction, Mannich reaction, Pinacol-Pinacolone, Wagner-Meerwein, Wolff, Hofmann and Beckmann rearrangements, Condensation reaction (Aldol condensation, Favorskii rearrangement, Wittig rearrangement). Pericyclic and Photochemical Reactions.

3. **Advanced Organic Chemistry:**
   Brief introduction of Organic synthesis, Total Synthesis, Semi Synthesis Biocatalyst, Green Chemistry, Microwave assisted Synthesis

Recommended Reading

1. Johnson, W. S. (2003). *Organic chemistry in the laboratory.* W. H. Freeman and Company.
2. Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley.
3. Brown, W. H., & Bursten, M. L. (2014). *Introduction to organic chemistry* (8th ed.). Wiley.
4. Vollhardt, K. P. C., & Schore, N. E. (2014). *Organic chemistry: Structure and function* (7th ed.). W. H. Freeman and Company.
5. Thomas, G. (2013). *Medicinal chemistry: A molecular and biochemical approach.* Oxford University Press.
6. Carey, F. A. (2007). *Advanced organic chemistry: Part A: Structure and mechanisms* (5th ed.). Wiley.
7. Prasad, N. D. V. G. S., & Shinde, S. C. (2009). *Pharmaceutical organic chemistry.* Pharma Book Syndicate.
8. Silverman, R. B. (2014). *The organic chemistry of drug design and drug action* (2nd ed.). Academic Press.

PHC-308 | Cr. Hrs. 1

Organic Chemistry (Lab) II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Demonstrate laboratory proficiency in identifying and synthesizing pharmaceutically important compounds using classical and green organic methods.

Contents

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

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Vollhardt, K. P. C., & Schore, N. E. (2014). *Organic chemistry: Structure and function* (7th ed.). W. H. Freeman and Company.
2. Thomas, G. (2013). Medicinal chemistry: *A molecular and biochemical approach*. Oxford University Press.
3. Silverman, R. B. (2014). *The organic chemistry of drug design and drug action* (2nd ed.). Academic Press.
4. Johnson, W. S. (2003). *Organic chemistry in the laboratory*. W. H. Freeman and Company.
5. Abraham, D. J. (2017). *Burger's medicinal chemistry and drug discovery* (8th ed.). Wiley.
6. Brown, W. H., & Bursten, M. L. (2014). *Introduction to organic chemistry* (8th ed.). Wiley.
7. Carey, F. A. (2007). *Advanced organic chemistry: Part A: Structure and mechanisms* (5th ed.). Wiley.
8. Prasad, N. D. V. G. S., & Shinde, S. C. (2009). *Pharmaceutical organic chemistry*. Pharma Book Syndicate.

PHC-310 | Cr. Hrs. 2

Biochemistry-II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Explain advanced biochemical roles of proteins, amino acids, and enzymes, including their metabolism, disorders, and pharmaceutical significance.
2. Analyze the structure, function, and therapeutic relevance of nucleic acids in gene therapy, drug delivery, and diagnostic applications.
3. Interpret the clinical significance of biochemical markers (e.g., bilirubin, creatinine, uric acid) in diagnosing liver and kidney disorders prevalent in Pakistan.

Contents

1. **Biochemistry Proteins and Amino acids: Proteins and Amino acids:**
   Define proteins and amino acids, classifications of proteins and amino acids, essential amino acids, peptide bonds, organizational levels, amphoteric properties, pharmaceutical importance of proteins and amino acids. Proteins and amino acids digestion, absorption, metabolism and excretion, biosynthesis and degradation of amino acids and its disorders, protein metabolism disorders, urea cycle and its disorders, biosynthesis and degradation of heme. Brief overview of protein and amino acid metabolic disorders.

2. **Biochemistry of Nucleic Acids:**
   Nucleic acid, purine and pyrimidine bases, nucleic acid uses in gene therapy, drug delivery, diagnostics, vaccines, targeted therapies, antisense therapy, bioanalysis, nanotechnology pharmaceutical importance.

3. **Biochemistry of Enzymes:**
   Enzymes, classification, inhibition, activation, specificity, allosteric enzymes, factors affecting rate of enzyme-catalyzed reaction, drug-enzyme interactions, pharmaceutical importance of enzymes, Coenzymes and their role in the regulation of metabolic processes.

4. **Biochemistry of Secondary Messengers:**
   Role of cAMP, Calcium ions and phosphoinositol in the regulation of metabolic processes.

5. **Introduction to clinical biochemistry:**
   Introduction and importance of clinical biochemistry. laboratory tests in diagnosis of diseases including uric acid, cholesterol, bilirubin and creatinine.

Recommended Reading

1. Lippincott Williams & Wilkins. (2020). *Lippincott's illustrated reviews: Biochemistry.* Lippincott Williams & Wilkins.
2. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). *Stryer's biochemistry* (8th ed.). W. H. Freeman and Company.
3. Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.
4. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7th ed.). W. H. Freeman and Company.
5. Devlin, T. M. (2016). *Textbook of biochemistry with clinical correlations* (8th ed.). Wiley-Liss.
6. Gout, A. M. (2019). *Biochemistry for the pharmaceutical sciences* (4th ed.). Wiley.
7. Berg, J. M., & Stryer, L. (2020). *Biochemistry* (9th ed.). W. H. Freeman and Company.
8. Hodges, R. S. (2019). *Biochemistry: A short course* (3rd ed.). Wiley.
9. Tortora, G. J., & Derrickson, B. H. (2020). *Principles of anatomy and physiology* (15th ed.). Wiley.
10. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science.
11. 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.

PHC-312 | Cr. Hrs. 1

Biochemistry (Lab) II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Interpret the clinical significance of biochemical markers (e.g., bilirubin, creatinine, uric acid) in diagnosing liver and kidney disorders prevalent in Pakistan.
2. Demonstrate accurate use of biochemical lab methods (e.g., Biuret, Jaffe, LFT/KFT) for quantitative analysis of biomolecules in biological samples.

Contents

Amino acids, Peptides and Proteins using Biuret and Ninhydrin method. Analysis of normal and abnormal components of Urine-Sugar, Uric acid, Bilirubin, Cholesterol and Creatinine. Estimation of Blood Glucose Level, Quantitative Analysis of Total Plasma Proteins by Biuret's Method, Construction of a Standard Curve, Estimation of Blood Urea Nitrogen, Estimation of Serum Bilirubin Level, Estimation of Serum Calcium Level, Estimation of Serum Uric Acid Level. Estimation of Serum Creatinine Level by Jaffe's Method, Heller's Test, Lead Sulfide Test, Nitroprusside Test. Liver Function Test. Kidney Function Test.

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2019). *Stryer's biochemistry* (8th ed.). W. H. Freeman and Company.
2. Akash, M. S. H., & Rehman, K. (2025). Biochemical aspects of metabolic disorders. Elsevier Academic Press.
3. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry* (7th ed.). W. H. Freeman and Company.
4. Devlin, T. M. (2016). *Textbook of biochemistry with clinical correlations* (8th ed.). Wiley-Liss.
5. Gout, A. M. (2019). *Biochemistry for the pharmaceutical sciences* (4th ed.). Wiley.
6. Berg, J. M., & Stryer, L. (2020). *Biochemistry* (9th ed.). W. H. Freeman and Company.
7. Hodges, R. S. (2019). *Biochemistry: A short course* (3rd ed.). Wiley.
8. Tortora, G. J., & Derrickson, B. H. (2020). *Principles of anatomy and physiology* (15th ed.). Wiley.
9. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science.
10. Lippincott Williams & Wilkins. (2020). *Lippincott's illustrated reviews: Biochemistry.* Lippincott Williams & Wilkins.
11. 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.

PHC-502 | Cr. Hrs. 3

Pharmaceutical Analysis-II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Explain the principles and pharmaceutical applications and of spectroscopic and chromatographic techniques including UV, IR, NMR, MS, AAS, HPLC, and GC.
2. Interpret spectra and chromatograms for, to assess identity, purity, and concentration of pharmaceutical substances
3. Apply instrumental methods to develop, optimize, and validate analytical procedures in line with pharmacopeial and regulatory standards.

Contents

1. **Spectroscopic Methods in Pharmaceutical Analysis:**
   Introduction, and principle of photometry, spectrophotometry, electromagnetic spectrum, electromagnetic radiation, energy levels and transitions, types of spectra, factors affecting spectrum,

determination of absorption maxima, applications of spectroscopic techniques.
i. Atomic Absorption and Emission Spectroscopy
ii. Ultraviolet Spectroscopy
iii. Infrared Spectroscopy
iv. Nuclear Magnetic Resonance Spectroscopy
v. Mass Spectrometry

2. **Chromatographic Methods:**
Principle and theory of chromatography, working and components of the following chromatographic methods, sample preparation for chromatography, applications.
i. Thin Layer Chromatography (TLC)
ii. High Performance Liquid Chromatography (HPLC)
iii. Gas Chromatography (GC)
iv. Ion Exchange Chromatography

Recommended Reading

1. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.
2. Golden W. Evings, (1985). Instrumental methods of chemical analysis (5th edition) Mc Graw Hill, London.
3. David G. Watson (2007). Pharmaceutical analysis, a text book for pharmacy students and pharmaceutical chemistry (2nd edition) Elsevier Churchill Livingston, UK.
4. Mendham J. Denney R.C, Barnes J.D, Thomas M and Sivasankar B (2011) Vogel's text book of quantitative chemical analysis (6th edition). Dorling Kindersley India.
5. Satinder Ahuja and Stephen Skypinski (2005). Hand book of modern pharmaceutical analysis academic press, California.
6. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
7. The International Pharmacopoeia (3rd edition) WHO. AITBS publisher, Kishan Noya Delhi.
8. United States Pharmacopeia (2020). United States Pharmacopeia and National Formulary (USP 43- NF 38). Rockville, MD: USP. British Pharmacopeia Commission (2022). British Pharmacopeia London: Stationary Office.

PHC-504 | Cr. Hrs. 1

Pharmaceutical Analysis (Lab) II

Course Learning Outcomes

After completion of this course the students will be able to:
1. Apply instrumental methods to develop, optimize, and validate analytical procedures in line with pharmacopeial and regulatory standards.
2. Demonstrate laboratory proficiency in operating instruments and performing assays, spectral analysis, and chromatographic separations for pharmaceutical compounds.

Contents

To perform at least ten (10) practicals; one (1) from each method / technique
1. Determination of UV-Visible absorption spectra of any API/raw material.
2. Determination of absorption maxima (λ max) of a given sample.
3. Determination of A1 of a given sample by UV-Visible spectrophotometry.
4. Assay of Pharmaceutical substances based on spectrophotometric methods.
5. Separation, identification and quantification of pharmaceutical substances by chromatographic methods such as TLC or HPLC or GC.
6. Method development procedure for pharmaceutical. Substance by UV-Visible Spectrophotometry or TLC or GC or HPLC.
7. Experimental methodology of validation of the developed method.

Recommended Reading

1. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.

2. Golden W. Evings, (1985). Instrumental methods of chemical analysis (5th edition) Mc Graw Hill, London.
3. David G. Watson (2007). Pharmaceutical analysis, a text book for pharmacy students and pharmaceutical chemistry (2nd edition) Elsevier Churchill Livingston, UK.
4. Mendham J. Denney R.C, Barnes J.D, Thomas M and Sivasankar B (2011) vogels text book of quantitative chemical analysis (6th edition). Dorling Kindersley India.
5. Satinder Ahuja and Stephen Skypinski (2005). Hand book of modern pharmaceutical analysis academic press, California.
6. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
7. The International Pharmacopoeia (3rd edition) WHO. AITBS publisher, Kishan Noya Delhi.
8. United States Parmacopeial (2020). United States Parmacopeia and National Formulary (USP 43- NF 38). Rockville,
9. MD: USP.British Parmacopeia Commission (2022). British Parmacopeia London: Stationary Office.

PHC-520 | Cr. Hrs. 3

Quantitative Reasoning – II (Bio-Statistics)

Course Learning Outcomes

After completion of this course the students will be able to:

1. Understand basic concepts of statistics and biostatistics.
2. Organize and present data using tables and graphs.
3. Calculate and interpret key descriptive statistical measures.
4. Apply basic curve-fitting methods.
5. Use probability rules and common probability distributions.
6. Perform simple regression and correlation analysis.
7. Conduct basic hypothesis testing and interpret results.

Contents

1. **Description of statistics:**
   Descriptive Statistics: What is Statistics? Importance of Statistics. What is Biostatistics? Application of Statistics in Biological and Pharmaceutical Sciences. How are samples selected?

2. **Organizing and displaying data:**
   Vriables, Quantitative and Qualitative Variables, Univariate Data, Bivariate Data, Random Variables, Frequency Table, Diagrams, Pictograms, Simple Bar Charts, Multiple Bar Charts, Histograms.

3. **Summarizing data and variation:**
   The Mean, the Median, the Mode, the Mean Deviation, the Variance and Standard Deviation, Coefficient of Variation.

4. **Curve fitting:**
   Fitting a Straight Line. Fitting Parabolic or High Degree Curve.

5. **Probability**
   Definitions, Probability Rules, Probability Distributions (Binomial & Normal Distributions)

6. **Simple regression and correlation:**
   Introduction. Simple Linear Regression Model. Correlation co-efficient.

7. **Test of hypothesis and significance:**
   Statistical Hypothesis. Level of Significance. Test of Significance. Confidence Intervals, Test involving Binomial and Normal Distributions.

8. **Student "t", "F" and Chi-Square distributions:**
   Test of Significance based on "t", "F" and Chi-Square distributions.

9. **Analysis of variance:**
   One-way Classification, Two-way Classification, Partitioning of Sum of Squares and Degrees of Freedom, Multiple Compression Tests such as LSD, The analysis of Variance Models.

10. **Statistical package:**
    An understanding of data analysis by using different statistical tests using various statistical software's like SPSS, Minitab, Statistica etc.

Recommended Reading

1. Daniel WW. Bio-Statistics: Foundation for Analysis in Health Science. 9th Ed. Wiley Publishers; 2009.
2. Nilton JS. Statistical Methods in Biological and health Sciences. 3rd Ed. McGrew Hill; 1998.
3. Hoel PG, PortSC, Stone CJ. Introduction to Statistical Theory. 1st Ed. Brooks Cole; 1972.
4. Samuels M. Statistics for the life sciences. 3rd Ed. Dellen Publishers co; 2002. 5. Zar JH. Biostatistical analysis. 4th Ed. Francis Hall; 1999.

PHC-610 | Cr. Hrs. 2

Pharmaceutical Quality Control

Course Learning Outcomes

After completion of this course the students will be able to:

1. Understand the concept and basis of quality of pharmaceuticals and related chemical substances.
2. Describe the role of regulatory agencies for the quality of pharmaceuticals and herbal products.
3. Understand the method development protocols and validation process as per regulatory requirements.
4. Describe the latest concept of quality being practiced in the pharmaceutical industry.

Contents

1. **Quality Control of Chemical Substances and Regulations**
   - 1.1. Definition of quality, quality control and quality assurance.
   - 1.2. Basis and concept of quality in pharmaceuticals.
   - 1.3. Sources of impurities in raw material and chemical substances used in pharmaceutical and herbal products.
   - 1.4. Limit test for impurities.
   - 1.5. Role of quality control in ensuring safety of raw materials.
   - 1.6. Overview of national and international agencies (DRAP/WHO/PICs) dealing with the quality of API's and raw materials.
   - 1.7. Preparation of BOP's and SOP's.
   - 1.8. Good laboratory practices (GLP)

2. **General requirements for the quality evaluation of API's, raw materials and chemical substances**
   - 2.1. A brief account of analytical methods used in drug analysis (only name and principles).
   - 2.2. Calibration of glassware and instruments.
   - 2.3. Sampling, procedure, handling, storage and documentation of APIs.
   - 2.4. Standards and standardization process.
   - 2.5. Pharmacopeial tests and specifications.
   - 2.6. Evaluation of Pharmaceuticals and herbal products
   - 2.7. Causes of poor quality and general requirements

3. **Analytical Method Development and Validation**
   - 3.1. Selection criteria of analytical method/technique based on analyte properties.
   - 3.2. Parameters of analytical method for instance UV, HPLC, GC.
   - 3.3. Analytical method development, validation and optimization of its parameters as per ICH guidelines.

4. **Quality Risk Management and Product Development:**
   - 4.1. Introduction to ICH Q9, Risk Definition, Assessment, Control, and Review, Tools in Quality Risk Management, change control.
   - 4.2. Overview of ICH Q10, Lifecycle Stage Goals, Management Responsibilities, Enablers: Knowledge Management and Quality Risk Management, Continual Improvement of Process Performance and Product Quality, Continual Improvement of the Pharmaceutical Quality System.

5. **Total Quality Management (TQM) – A New Approach**
   5.1. Definition, concept, and significance of TQM in pharmaceuticals
   5.2. Basic elements of TQM

Recommended Reading

1. International Conference on Harmonization. (2005). ICH harmonized tripartite guideline: Validation of analytical procedures: Text and methodology Q2(R1).
2. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
3. World Health Organization. (2007). WHO guidelines for assessing quality of herbal medicines with reference to contaminants and residues.
4. Swartz, M. E., & Krull, I. S. (2012). Analytical method development and validation. CRC Press.
5. Ermer, J., & Nethercote, P. W. (2018). Method validation in pharmaceutical analysis: A guide to best practice (2nd ed.). Wiley-VCH.
6. World Health Organization. (2024). Quality assurance of pharmaceuticals: A compendium of guidelines and related materials (10th ed.). WHO Press.
7. World Health Organization. (2011). Laboratory quality management system: Handbook. WHO Press.
8. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.
9. United States Pharmacopeial Convention. (2020). United States Pharmacopeia and National Formulary (USP 43–NF 38). Rockville, MD: USP.
10. British Pharmacopoeia Commission. (2022). British Pharmacopoeia. London: Stationery Office

PHC-612 | Cr. Hrs. 1

Pharmaceutical Quality Control (Lab)

Course Learning Outcomes

After completion of this course the students will be able to:

1. Determine the concept and basis of quality of pharmaceuticals and related chemical substances.
2. Understand the method development protocols and validation process as per regulatory requirements

Contents

1. Calibration of glass wares.
2. Calibration of analytical balance
3. Evaluation of raw materials in pharmaceuticals.
4. Chemical testing of various APIs, raw materials and chemical substances as per pharmacopeial specifications.
5. Standardization of reagents.
6. Determination of impurities (limit test as per pharmacopeial specification).
7. Method development procedure analytical techniques sch as UV-visible spectrophotometry or chromatographic methods.
8. Validation methodology of any developed method.
9. Risk management and change control.

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. International Conference on Harmonization. (2005). ICH harmonized tripartite guideline: Validation of analytical procedures: Text and methodology Q2(R1).
2. Akash, M. S. H., & Rehman, K. (2025). Essentials of pharmaceutical analysis. 2nd Edition. Springer Nature.
3. World Health Organization. (2007). WHO guidelines for assessing quality of herbal medicines with reference to contaminants and residues.
4. Swartz, M. E., & Krull, I. S. (2012). Analytical method development and validation. CRC Press.
5. Ermer, J., & Nethercote, P. W. (2018). Method validation in pharmaceutical analysis: A guide to best practice (2nd ed.). Wiley-VCH.

6. World Health Organization. (2024). Quality assurance of pharmaceuticals: A compendium of guidelines and related materials (10th ed.). WHO Press.
7. World Health Organization. (2011). Laboratory quality management system: Handbook. WHO Press.
8. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2014). Fundamentals of Analytical Chemistry (9th ed.). Cengage Learning.
9. United States Pharmacopeial Convention. (2020). United States Pharmacopeia and National Formulary (USP 43–NF 38). Rockville, MD: USP.
10. British Pharmacopoeia Commission. (2022). British Pharmacopoeia. London: Stationery Office.

PHC-706 | Cr. Hrs. 3

Medicinal Chemistry-II

Course Learning Outcomes

After completion of this course the students will be able to:

1. Explain the chemical structures, SAR, and therapeutic roles of cardiovascular, antidiabetic, diuretic, and antimicrobial agents relevant to diseases prevalent in Pakistan.
2. Analyze structure–activity relationships (SAR) of drug classes including antituberculars, antimalarials, antivirals, and immunomodulators.
3. Evaluate therapeutic potential and mechanism of action of drug molecules using medicinal chemistry concepts to support rational drug design and discovery

Contents

General properties, Chemistry, SAR, Biological action and therapeutic uses of the following:

1. **Cardiovascular Agents**
   i. **Antihypertensives:** ACE Inhibitors (Captopril and Enalapril), β-Blockers (Propranolol and Pindolol), Ca^{2+} Channel Blockers (Verapamil)
   ii. **Antihyperlipidemics:** Statins (Atorvastatin)

2. **Diuretics:**
   Carbonic anhydrase inhibitors (Acetazolamide and Dichlorphenamide) Thiazides and hydrothiazide derivatives (Hydrochlorothiazide and Benzthiazide) Loop Diuretics (Furosemide, ethacrynic acid) Potassium sparing diuretics (spironolactone and eplerenone)

3. **Antidiabetics:**
   Biguanides (Metformin and related analogues), Sulfonylureas (Glibenclamide and related analogues), DPP-4 Inhibitors (Sitagliptin and related analogues).

4. **Antimicrobial & Antiparasitic Agents**
   i. **Antibiotics:** β-Lactams, Macrolides, Aminoglycoside, Tetracyclines and Quinolones.
   ii. **Antitubercular Drugs:**
      - First-Line anti-TB drugs (Isoniazid and Rifampicin),
      - Second line anti-TB drugs (Fluoroquinolones and others)
        Newer / Repurposed Drugs for MDR/XDR-TB (Diarylquinoline (Bedaquiline) and Oxazolidinone (Linezolid).

   iii. **Sulfonamides:**
   N1-Substituted (Sulfanilamide, Sulfadimidine, Sulfacetamide and Sulfafurazole) and N4-Substituted (Succinyl Sulfathiazole and Phthalyl Sulfathiazole)
   iv. Antimalarials:
   4-Aminoquinolines (Chloroquine), 8-Aminoquinolines (Pamaquine), 9- Aminoacridines (Mepacrine), Biguanides (Proguanil), Endoperoxides (Artemisinin).

5. **Antivirals:**
   Nucleoside Analogues (Acyclovir and Ribavirin), Protease Inhibitors (Ritonavir).

6. **Immunomodulators:**
   Cyclic Polypeptide (Cyclosporine) and Purine Antimetabolite (Azathioprine).

Recommended Reading

1. Foye, W. O., Lemke, T. L., & Williams, D. A. (2020). *Foye's Principles of Medicinal Chemistry* (8th ed.). Lippincott Williams & Wilkins
2. Silverman, R. B., & Holladay, M. W. (2020). *The Organic Chemistry of Drug Design and Drug Action* (3rd ed.). Academic Press.
3. Patrick, G. L. (Ed.). (2011). *Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry* (12th ed.). Wolters Kluwer.
4. Wermuth, C. G., & Livi, G. P. (2019). *Chemistry of Drug Design and Drug Action* (4th ed.). Academic Press.
5. Hansch, C., & Fujita, T. (2020). *Theoretical Drug Design: Volume I - Structure-Activity Relationships* (2nd ed.). Springer.
6. Patel, M. (2018). *Medicinal Chemistry: An Introduction* (2nd ed.). Wiley-Blackwell.
7. Eger, E. I. (2020). *Principles of Medicinal Chemistry* (2nd ed.). Springer.

PHC-708 | Cr. Hrs. 1

Medicinal Chemistry (Lab) II

Course Learning Outcomes

After completion of this course the students will be able to:
Identify, synthesize, and characterize key pharmaceutical compounds using modern synthetic and analytical techniques.

Contents

NOTE: Practical of the subject shall be designed from time to time on the basis of the above- mentioned theoretical topics and availability of the facilities.

1. **Synthesis of medicinal compounds:**
   Synthesis of Benzimidazole, Benzotriazole, Benzocaine, 3-methyl-1-phenyl pyrazole-5-one, 4-benzylidene-2-phenyl oxazole-5-one, Barbituric acid, Phenytoin, Phenothiazine, Acetanilide, Paracetamol, Aspirin derivatives, Salicylic Acid, Methyl Salicylate, Azobenzene, Benzoic Acid, 5-Hydroxy-1,3-benzoxazol-2-one, p-Nitrosophenol, 3-Nitrophthalic Acid, o-Chlorobenzoic Acid, and Phenylalanine, Dibenzalacetone, benzoin, benzamide, benzanilide, benzyl benzoate, phenyl benzoate.
2. **Identification Tests:**
   Paracetamol – oxidation with sodium hypochlorite (violet color); Aspirin – $FeCl_3$ test after hydrolysis (violet complex); Salicylic Acid – $FeCl_3$ test (deep violet color); Benzoic Acid – sublimation and effervescence with $NaHCO_3$ (confirms carboxylic acid group); Benzocaine – diazotization-coupling test (orange-red azo dye formation); Barbituric Acid – copper sulfate test (violet color); Acetanilide – melting point (~114°C) or nitration to form yellow p-nitroacetanilide.

(Note: A minimum of 10 practicals will be conducted)

Recommended Reading

1. Silverman, R. B., & Holladay, M. W. (2020). *The Organic Chemistry of Drug Design and Drug Action* (3rd ed.). Academic Press.
2. Wermuth, C. G., & Livi, G. P. (2019). Chemistry of Drug Design and Drug Action (4th ed.). Academic Press.
3. Foye, W. O., Lemke, T. L., & Williams, D. A. (2020). Foye's Principles of Medicinal Chemistry (8th ed.). Lippincott Williams & Wilkins.
4. Hansch, C., & Fujita, T. (2020). Theoretical Drug Design: Volume I - Structure-Activity Relationships
5. (2nd ed.). Springer.
6. Patel, M. (2018). Medicinal Chemistry: An Introduction (2nd ed.). Wiley-Blackwell.
7. Eger, E. I. (2020). Principles of Medicinal Chemistry (2nd ed.). Springer.

Courses Schedule
Pharm. D. (Deficiency) Program

1st Semester			2nd Semester		
Course NO.	**Title of Course**	**Cr. Hrs.**	**Course NO.**	**Title of Course**	**Cr. Hrs.**
PHC - 303(D)	Pharmaceutical Chemistry (Organic and Inorganic)	2	PHC - 406(D)	Physical Chemistry (Lab)	2
PHC - 505(D)	Theoretical Basis of Quality Control	2	PHC - 710(D)	Medicinal Chemistry	3
PHC - 707(D)	Pharmaceutical Analysis	2	-	-	-
Total **5 courses**, making **11Credit hours** in one year					

Pharm. D. Deficiency Courses - Outline
First Semester

PHC-303 (D) | Cr. Hrs. 2
Pharmaceutical Chemistry (Organic and Inorganic)

1. **Organic reactions:** Baeyer-Villiger oxidation; Diels Alder reaction; Grignard's reaction, metal hydride reduction and Wolff Krishner reduction, Friedel Craft's reaction, Perkin reaction, Cannizzaro reaction.

2. **Carbonium ion rearrangements:** Pinacol-pinacolone, Wagner-Meerwein, Wolf, Hofmann and Beckmann rearrangements.

3. **Carbanions:** condensation reaction (Aldol condensation; Favorskii rearrangement; Wittig reaction).

4. **Inorganic Drugs**
   Occurrence, preparation, physical characteristics, chemical properties, purity test, incompatibilities, assay and pharmaceutical uses of inorganic drugs such as:

Aluminum hydroxide	Ammonium chloride
Sodium carbonate	Sodium chloride
Sodium thiosulphate	Sodium tetraborate (borax)
Magnesium carbonate	Potassium chloride
Lithium carbonate	Sodium nitrite
Calcium gluconate	Calcium carbonate
Calcium chloride	Calcium lactate
Ferrous fumarate	Ferrous sulfate
Ferrous gluconate	Iron polysaccharide
Silver nitrate	Antimony gluconate
Iodine	Hydrogen per oxide
Boric acid	Zinc oxide

Recommended Reading

1. Sykes, P. (1978). *A guidebook to mechanisms in organic chemistry* (4th ed.). Longman Group Ltd.
2. Solomons, T. W. G. (1992). *Organic chemistry* (5th ed.). John Wiley & Sons, Inc.
3. Adejare, A. (Ed.). (2020). *Remington: The science and practice of pharmacy* (23rd ed.). Academic Press. https://doi.org/10.1016/C2018-0-02594-0
4. *Vogel's textbook of quantitative inorganic analysis: Including elementary instrumental analysis (*6th ed.). Longman.
5. Parkes, G. D. (1956). *Mellor's modern inorganic chemistry.* Longman Green & Co.

PHC-505 (D) | Cr. Hrs. 2
Theoretical Basis of Quality Control

1. Pharmaceutical sciences and its relation to other sciences.
2. Brief historical outline.
3. Raw material for drugs.
4. Sources of impurities in pharmaceuticals.
5. Quantitative and qualitative analysis (general information).

6. Standardization of pharmaceuticals and formulated products.
7. Quality control system for drugs and pharmaceuticals.
8. Causes of poor quality and general requirements.
9. Total quality management, a new approach.
10. Validation methodology and statistical treatment of analytical data.

Recommended Reading

1. Watson, D. G. (1999). *Pharmaceutical analysis: A textbook for pharmacy students and pharmaceutical chemists*. Churchill Livingstone.
2. Pott, L. W. (1987). *Quantitative analysis: Theory and practice*. Harper & Row Publishers.
3. Adejare, A. (Ed.). (2020). *Remington: The science and practice of pharmacy* (23rd ed.). Academic Press. https://doi.org/10.1016/C2018-0-02594-0.
4. United States Pharmacopeial Convention. (2008). *United States Pharmacopeia 31–National Formulary 26* (USP 31–NF 26). United States Pharmacopeial Convention, Inc.
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2006). *Vogel's textbook of practical organic chemistry* (6th ed.). Longman.

PHC-707 (D) | Cr. Hrs. 2

Pharmaceutical Analysis

To study the principles and applications of spectroscopic and chromatographic method with special reference to

1. Assay of pharmaceutical compounds.
2. Separation, identification and quantitation of a drug.
3. Method, development procedure of a drug.
4. Experimental methodology of validation of a drug.

Recommended Reading

1. Medicines and Healthcare products Regulatory Agency (MHRA). (2025). *British Pharmacopoeia 2025* (Vols. 1–6). The Stationery Office.
2. Ewing, G. W. (1985). *Instrumental methods of chemical analysis* (5th ed.). McGraw-Hill.
3. Skoog, D. A., Holler, F. J., & Nieman, T. A. (2000). *Principles of instrumental analysis* (5th ed.). Brooks/Cole.
4. United States Pharmacopeial Convention. (2008). *United States Pharmacopeia 31–National Formulary 26* (USP 31–NF 26). United States Pharmacopeial Convention, Inc.
5. Furniss, B. S., Hannaford, A. J., Smith, P. W. G., & Tatchell, A. R. (2006). *Vogel's textbook of practical organic chemistry* (6th ed.). Longman.

Pharm. D. Deficiency Courses - Outline
Second Semester

PHC-406 (D) | Cr. Hrs. 2

Physical Chemistry (Lab.)

1. Distillation of a mixture.
2. Distillation of an azeotropic mixture with minimum/maximum boiling point.
3. Determination of variation of miscibility with temperature.

4. Absorption curve of an indicator as a function of pH.
5. Composition of a complexion in solution.
6. Determination of molar refraction of a solid substance by dissolving it in a solvent.
7. Molecular weight determination.
8. Determination of the first-order rate constant for acid catalyzed hydrolysis of a given sample.
9. Determination of the first-order rate constant for the decomposition of a given sample.
10. Determination of effect of change of temperature in the rate of reaction.
11. To study the stability of a drug subjected to various stress conditions.
12. Determination of heat of solutions from solubility.

Recommended Reading

1. Higuchi, T., & Brochmann-Hanssen, E. (Eds.). (1961). *Pharmaceutical analysis*. *Interscience* (Wiley).)
2. Barrow, G. M. (1973). *Physical chemistry* (3rd ed.). McGraw-Hill.
3. Hussain, F. I. (1991). *Physical chemistry* (3rd ed.).
4. Glasstone, S. (1946). *Textbook of physical chemistry* (2nd ed.). Macmillan & Company Ltd.

PHC-710 (D) | Cr. Hrs. 3

Medicinal Chemistry

1. **DNA recombinant technology/genetic engineering (with reference to drug designing).**

2. **To study the chemistry, structure, mechanism of action, structure activity relationship and therapeutic applications of the following.**
   a. Hypoglycemic agents such as sulfonylureas tolbutamide, chlorpropamide, acetohexamide, glipizide, glyburide.
   b. Antibiotics such as penicillin, cephalosporins, streptomycin, chloramphenicol, tetracyclines, kanamycin and erythromycin.
   c. Antimalarial agents such as 4-aminoquinolines, 8-aminoquinolines, 9-amino acridines, biguanides, pyrimidine, analogues, mefloquine, cinchona alkaloids.
   d. Anthelmintics such as piperazine derivatives, thiabendazole, medendazole, pyrantal.
   e. Antiviral agents such as acyclovir, tromantadine hydrochloride, ribavirin.
   f. Immunosuppressive agents such as azathioprine, cyclosporine.

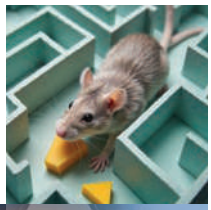
3. **To study the biosynthesis, drug designing and action of the following:**
   a. Autocoids such as prostaglandins, leukotrienes and eicosanoids.
   b. Adrenergic and cholinergic agents, neurotransmitters, receptors, agonists and antagonists.

Recommended Reading

1. Foye, W. O., Lemke, T. L., & Williams, D. A. (2008). *Foye's principles of medicinal chemistry* (6th ed.). Lippincott Williams & Wilkins.
2. Wilson, C. O., Gisvold, O., & Doerge, R. F. (1998). *Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry* (12th ed.). Lippincott-Raven Publishers.
3. Wolff, M. E. (Ed.). (2003). *Burger's medicinal chemistry and drug discovery* (6th ed.). Wiley-Interscience.
4. Gringauz, A. (1997). *Introduction to medicinal chemistry: How drugs act and why*. Wiley-VCH.
5. Silverman, R. B. (1992). *The organic chemistry of drug design and drug action*. Academic Press.

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Department of
Pharmacology





Message

The Chairperson, Department of Pharmacology

Dear Students, the pharmacy profession stands as a vital pillar of healthcare, ensuring the safe, effective, and responsible use of medications while contributing to patient care, research, and community wellbeing. As future pharmacists, you are preparing to take on a role that demands knowledge, compassion, and professional integrity.

The Department of Pharmacology provides the essential scientific foundation that guides rational therapeutic decisions. Our focus is to help you understand how drugs work and how to apply this knowledge safely in clinical practice. Through dedicated teaching and mentorship, we aim to strengthen your analytical skills and support your growth as competent healthcare professionals.

As you move through the five years of the Pharm.D. program, I encourage you to stay committed to learning, uphold ethical values, and strive for excellence in all aspects of your training.
Wishing you continued success in your Pharm.D. journey.

Dr. Azra Riaz
Associate Professor

Chairpers

Department of Pharmacology

The Department of Pharmacology is one of the important Departments of the Faculty of Pharmacy and Pharmaceutical Sciences since 1973, not only sharing a major load at the under graduate level but also preparing students to fill the gap by suitably qualified manpower in the field of pharmacy at post graduate levels. The expansion of the department and graduate programs in the areas of modern pharmacology including Neuropharmacology, Toxicology and Biochemical Pharmacology is expected to place the department among high research ranking Departments of the University.

The major academic objectives of the Department are to facilitate Basic and Applied Research, educate undergraduate, graduate and professional students in various disciplines and provide academic excellence. The Department of Pharmacology has so far produced a great number of Ph.Ds. in the Faculty of Pharmacy and Pharmaceutical Sciences and a large number of M.Phil. and M.Pharm. The Department is composed of highly competent primary faculty, research faculty and technical support staff.

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website: **https://www.uok.edu.pk/faculties/pharmacology/index.php**

Department of **Pharmacology**

Vision

The Department of Pharmacology at Karachi University's Faculty of Pharmacy and Pharmaceutical sciences envisions becoming a premier research-driven academic hub, fostering excellence in pharmacological sciences. We strive to educate and inspire future pharmacologists, empowering them to deliver compassionate patient care and contribute meaningfully to society.

Mission

The Department of Pharmacology is committed to:

- Providing high-quality undergraduate education and training in pharmacology
- Conducting innovative research that advances pharmacological sciences and improves human health
- Fostering a culture of academic excellence, critical thinking, and lifelong learning
- Developing competent pharmacologists who can provide optimal patient care
- Serving the community through outreach, education, and collaborative research initiatives.

Dr. Azra Riaz

Chairperson & Associate Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2012

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Dr. Azra Riaz is an accomplished Associate Professor at the Department of Pharmacology, Faculty of Pharmacy & Pharmaceutical Sciences, University of Karachi, with a deep-rooted academic connection to the institution where she earned her Ph.D., M.Phil., and B.Pharm. Joining the faculty in 2012, Dr. Riaz has since been a vital contributor to the university's academic and research landscape.

Her teaching and research interests are notably diverse, encompassing Pharmacology, Physiology and Pathology, providing a holistic approach to the field of Pharmacology. Dr. Riaz's research endeavors are particularly broad and impactful, focusing on critical areas such as biochemical and hematological parameters, coagulation, inflammation, and neuropharmacology. This wide range of research interests underscores her versatile expertise and commitment to exploring complex biological processes and their pharmacological implications. Her significant tenure since 2012 and her varied research focus highlight a dedicated and productive career aimed at advancing scientific knowledge and contributing to the education of future professionals in the field of Pharmacology.

Dr. Syeda Afroz

Professor

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2006

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Dr. Syeda Afroz is a respected Professor at the University of Karachi, where she has been a dedicated member of the faculty since 2006. Her strong academic foundation includes a Ph.D., M.Phil., and B.Pharm., all earned from the University of Karachi, underscoring her profound connection to the institution. Dr. Afroz's primary area of interest and teaching expertise lies in General Pharmacology, providing a comprehensive understanding of drug actions and their effects. Her research endeavors are particularly concentrated in the specialized field of Neuropharmacology, focusing on the intricate interactions of drugs with the nervous system. Her long-standing tenure at the University of Karachi since 2006 signifies a career devoted to advancing pharmacological knowledge and contributing to the academic community. Her commitment ensures the continued education of future pharmacists and researchers in critical areas of pharmacology.

Dr. Afshan Siddiq

Professor

Qualification
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2006

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Prof. Dr. Afshan Siddiq, a Distinguished Professor, University of Karachi, has established herself as a leading figure in pharmacological education and research. With a strong academic foundation, including a Ph.D., M.Phil., and B.Pharm. from the University of Karachi, Dr. Siddiq has been an integral part of the institution since 2006. Her research expertise spans Systemic Pharmacology, Biochemistry, and Toxicology, with a particular focus on Biochemical Pharmacology. Dr. Siddiq's publication record showcases her contributions to various areas of pharmacology, including antipsychotic efficacy, anticancer agents, and periodontal disease progression in diabetic patients. As an accomplished academic, Dr. Siddiq has held key leadership positions, including membership in departmental and university-wide committees, such as the Departmental Research Committee and departmental Ethical Committee, Member of Hungarian Society for Experimental and Clinical Pharmacology, and Member Affiliation committee UOK etc. Her editorial roles include Associate Editor for the Journal of Applied and Basic Sciences and Associate Editorial Board Member for The Open Pharmacology Journal, and Editorial Board Member for the Pakistan Journal of Pharmaceutical Sciences. Throughout her tenure, Dr. Siddiq has consistently demonstrated a commitment to academic excellence, research innovation, and institutional leadership, solidifying her reputation as a prominent figure in the field of Pharmacology.

Dr. Saira Saeed Khan

Associate Professor

Qualification
Ph.D., M.Phil., B.Pharm
(University of Karachi)

Year of Association
2012

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Dr. Saira Saeed Khan is a highly esteemed Associate Professor within the Department of Pharmacology at the University of Karachi. A proud alumna of the institution, Dr. Khan completed all her higher education there, earning her B.Pharm., M.Phil, and Ph.D. This deep-rooted connection to the University of Karachi began in 2012 when she joined the Department of Pharmacology, and since then, she has been an invaluable asset, significantly contributing to both pharmacology education and research.

Dr. Khan's research is both diverse and impactful, with a particular focus on neuropharmacology and neurodegenerative diseases. Her expertise also extends to endocrinological disorders, specifically diabetes and Polycystic Ovary Syndrome (PCOS), addressing critical health challenges through her dedicated work.

In a testament to her academic excellence and research prowess, Dr. Khan was awarded the prestigious Fulbright scholarship in 2024. This enabled her to complete a Post-doctorate in Pharmacology at the University of Toledo, Ohio, USA. This invaluable international experience has undoubtedly broadened her perspectives, further enriching her commitment to advancing scientific knowledge and fostering academic excellence within her field.

Dr. Shadab Ahmed

Associate Professor

Qualification
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(University of Karachi)

Year of Association
2012

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Dr. Shadab Ahmed is a highly respected Associate Professor at the University of Karachi, where he has consistently demonstrated exceptional loyalty and commitment as a pharmacologist since joining in 2012. Having earned his Ph.D., M.Phil., and B.Pharm. from the University of Karachi, Dr. Ahmed possesses a deep-rooted understanding and dedication to his alma mater. His pedagogical and research interests span a comprehensive range of subjects including Physiology, Pathology, Biochemistry, and Pharmacology, reflecting his broad expertise within the pharmaceutical and Pharmacological sciences.

Dr. Ahmed's specific research endeavors are concentrated in the intricate field of Neuropharmacology, where he actively contributes to understanding the effects of drugs on the nervous system. Known for his unwavering dedication to teaching, he consistently goes above and beyond to impart knowledge and inspire his students. His long tenure and continuous involvement highlight a career marked by academic excellence and a profound commitment to both education and cutting-edge research in pharmacology.

Dr. Sadia Ghousia Baig

Assistant Professor

Qualification
Ph.D., M.Phil., B.Pharm.
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Year of Association
2006

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Dr. Sadia holds a Bachelor of Pharmacy (B.Pharm.), Master of Philosophy (M.Phil.) in Pharmacology, and a Ph.D. in Pharmacology from the University of Karachi, with over 24 years of teaching experience in Pharmacy, Medical, and Dental Colleges. Her interests lie in clinical studies and the basic pharmacology of medicinal plants. Dr. Sadia is an HEC-approved supervisor for M.Phil. and Ph.D. students and has authored more than 45 research articles. In addition to teaching Biochemistry and various Pharmacology courses to Pharm.D and research students, she has served as a reviewer for HEC research grant and scientific journals such as PJPS and RADS JPPS. She has also worked as a member of several committees, including the Board of Studies, Departmental Research, Quality Enhancement, Time-table, Catalogue Review, at the University of Karachi and Procurement Committee Dow University of Health Sciences.

Dr. Nuzhat Sultana

Assistant Professor

Qualification
Ph.D., M.Phil., B.Pharm.
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Year of Association
2012

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Dr. Nuzhat Sultana B.Pharm., M.Phil. and Ph.D. (Pharmacology) is an Assistant Professor in the Department of Pharmacology, Faculty of Pharmacy & Pharmaceutical Sciences, University of Karachi. Throughout Dr. Nuzhat's career, she has atmosphere where active inquiry, critical thinking, and the synthesis of theoretical learning with practical application has been promoted. She teaches evidence-based instruction and the development of professional competencies, which has been recognized as an improvement to students' learning experiences. Dr. Nuzhat focused on examining the interplay between neuroscience and toxicology, examining how different agents affect neural function, behavior, and general physiological health. Her research expertise is grounded in a strong understanding of pharmacological mechanisms and examining neurotoxic effects and identifying potential therapeutic interventions. The purpose of this work is to extend understanding of neuronal pathways and to develop strategies to prevent or minimize toxin induced damage.

Dr. Sana Sarfaraz

Assistant Professor

Qualification
Ph.D., M.Phil., Pharm-D
(University of Karachi)

Year of Association
2019

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Dr. Sana Sarfaraz is an accomplished academician and researcher affiliated with the Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. She holds a Ph.D. in Pharmacology from the University of Karachi, where she also completed her master's in pharmacology and Doctor of Pharmacy (Pharm-D) with top honors. Her research interests include Neuropharmacology, Endocrinology, and Clinical Pharmacy.

Dr. Sarfaraz has published numerous research articles in various scientific journals and has been recognized with multiple awards and medals for her academic excellence. She also serves as an editorial board member and reviewer for several prestigious journals. She is associated with supervising multiple student clubs, including the Karachi University Pharmacy Science Club and the Community Pharmacy Services. Under her leadership, students have completed various projects concerning women's health and have generated awareness among the female population. She also has experience working as a Pharmacist in the Agha Khan University Hospital and has been affiliated as a training coordinator in various clinical clerkship programs of undergraduate Pharm. D students.

Dr. Adnan Iqbal

Lecturer

Dr. Adnan is working as a Lecturer (BPS-18) at the Department of Pharmacology, University of Karachi since 2019. He is dedicated to providing an education that is actively engaged, critical thinking, and emphasizes practical relevance. He has been recognized for fostering an academic environment that promotes learning and professional development. Throughout his tenure at the University of Karachi, his research contributions in the fields of metabolic disorders and neuropharmacology have been recognized with invitations to present at notable national and international conferences. These distinctions validate his continued efforts to make meaningful contributions to the academic and scientific communities.

Qualification
Ph.D., M.Phil., Pharm-D (University of Karachi)

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2019

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Board of Studies

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University of Karachi, Karachi

Dr. Afshan Siddiq
Professor
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Dr. Sana Sarfaraz
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Dr. Adnan Iqbal
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Dr. Fareeda Islam
Professor and Head
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Karachi Medical & Dental College, Karachi

Dr. Mahy Rukh
Professor
Department of Pharmacology,
DOW University of Health Sciences
(OJHA Campus), Karachi

Dr. Subia Jamil
Associate Professor
Department of Pharmacology,
Jinnah University for Women, Karachi

Dr. Syed Saad Hussain
Senior Manager
Medical Affairs and Business Development,
Tabros Pharma (Pvt.) Ltd. Head Office, 32-1/C
Block 6, PECHS, Block-6, Karachi

Pharm. D. Courses
First Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHL-313	Physiology - I	3	Allied/Inter.
PHL-315	Physiology (Lab) - I	1	Allied/Inter.
Second Professional			
PHL-405	Pharmacology and Therapeutics - I	3	Core
PHL-407	Pharmacology and Therapeutics (Lab) - I	1	Core
PHL-413	Pathology	2	Allied/Inter.
PHL-415	Pathology (Lab)	1	Allied/Inter.
Third Professional			
PHL-505	Pharmacology and Therapeutics - III	3	Core
PHL-507	Pharmacology and Therapeutics (Lab) - III	1	Core
PHL -519	Fehm-e-Quran - II	1	General Edu.
Fifth Professional			
PHL-711	Clinical Pharmacology	2	Core
PHL-713	Clinical Pharmacology (Lab)	1	Core

Pharm. D. Courses
Second Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHL-314	Anatomy and Histology	2	Allied/Inter.
PHL-316	Anatomy and Histology (Lab)	1	Allied/Inter.
PHL-318	Physiology - II	3	Allied/Inter.
PHL-320	Physiology (Lab) - II	1	Allied/Inter.
PHL-322	Islamic Studies	2	General Edu.
Second Professional			
PHL-410	Pharmacology and Therapeutics - II	3	Core
PHL-412	Pharmacology and Therapeutics (Lab) - II	1	Core
PHL-418	Fehm-e-Quran - I	1	General Edu.
Third Professional			
PHL-506	Pharmacology and Therapeutics - IV	3	Core
PHL-508	Pharmacology and Therapeutics (Lab) - IV	1	Core
Fifth Professional			
PHL -716	Bioethics	2	General Edu.
Total **22 Courses** worth **39 Credit Hours** in five years			

Pharm. D. Courses – Outline
First Semester

PHL-313 | Cr. Hrs. 3

Physiology-I

Course Learning Outcomes

At the end of this course the student 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. Explain the structure and types of skeletal muscles, how they contract, and the role of the neuromuscular junction in muscle activity.
3. 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.
4. Outline the process of digestion and absorption, including digestive secretions, how they are regulated, and the steps from eating to defecation.
5. Describe the structure and function of the circulatory and lymphatic systems, including blood vessels, and explain how blood pressure is regulated.
6. 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.

Contents

1. **Basic Cell Functions**
   a) Overview of the physical structure of the cell.
   b) Extracellular fluid, intracellular fluid, phagocytosis, pinocytosis, cell cycle, apoptosis, movement of molecules across cell membranes: diffusion, active transport, co-transport, counter-transport, basic principles of osmosis, osmotic pressure and osmotic equilibrium, endocytosis and exocytosis.

2. **Muscle Physiology**
   Physiological anatomy of skeletal muscle, types of skeletal muscle fibers, general and molecular mechanisms of muscle contraction, physiological anatomy of neuromuscular junction.

3. **Circulation**
   Basic theory of circulatory function, structure and function of blood vessels (arteries, arterioles, capillaries, veins), blood pressure, total peripheral vascular resistance and total pulmonary vascular resistance, clinical methods of measuring systolic and diastolic blood pressures, arterial pressure and baroreceptor reflex, renin-angiotensin system, hematocrit, lymph channels of the body, formation of lymph.

4. **The Heart**
   Physiological anatomy of heart muscle, structure of heart, course of blood flow through heart, the cardiac cycle, conduction system of heart, heart sounds, murmurs, characteristics of normal electrocardiogram, relationship of electrocardiogram to the cardiac cycle, clinical significance of abnormal electrocardiographic patterns. Definitions: (systole, diastole, stroke volume, cardiac output, preload, afterload, ejection fraction).

5. **The Blood Cells**
   Red blood cells, erythropoiesis, formation and destruction of hemoglobin, types of white

blood cells, genesis of white blood cells, 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, platelets, formation of platelet plug, mechanism of blood coagulation, extrinsic and intrinsic pathways of initiating clotting, lysis of blood clot, blood types, agglutinogens, Rh blood types, plasma, serum.

6. **Digestion and Absorption of Food**
   Gastro-intestinal secretions (salivary secretions, gastric secretions, pancreatic secretions, biliary secretions), nervous and hormonal regulation of gastric secretions, mastication, deglutition, gastric emptying, intestinal movements (peristalsis, segmenting & mixing), biliary enterohepatic circulation, defecation, overview of enteric nervous system.

7. **Temperature Regulation**
   Mechanisms of body temperature regulation and pathophysiology fever and hypothermia.

Recommended Reading

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

PHL-315 | Cr. Hrs. 1

Physiology (Lab)- I

Course Learning Outcomes

By the end of this course, students will be able to:

1. Measure blood pressure and heart rate in humans and interpret physiological responses.
2. Perform venous blood sampling and administer intramuscular, subcutaneous, and intravenous injections using proper techniques.
3. Calculate body mass index (BMI) and interpret its health significance.
4. Observe and analyze peristaltic activity in rabbit jejunum.
5. Assess visual acuity, far and near vision, and visual fields (perimetry).
6. Identify abnormal electrocardiogram (ECG) patterns and discuss their clinical significance.
7. Observe effects of isotonic, hypotonic, and hypertonic solutions on red blood cells.

Contents

1. Determine the systolic and diastolic blood pressure of human volunteer using mercury sphygmomanometer and the heart rate by palpatory method
2. Determine the blood pressure and heart rate of 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).

Note: A minimum of 10 practicals should be conducted

Recommended Reading

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

PHL-405 | Cr. Hrs. 3

Pharmacology & Therapeutics-I

Course Learning Outcomes

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

1. Analyze fundamental principles of General Pharmacology, including pharmacokinetic and pharmacodynamic parameters, and apply this understanding to evaluate individual drug pharmacology.
2. 2. Classify molecular drug targets including receptor types, secondary messengers, and signaling pathways, and demonstrate their therapeutic implications through specific drug examples.
3. 3. Evaluate pharmacological mechanisms of autonomic nervous system drugs and justify their clinical applications in professional healthcare scenarios.
4. 4. Demonstrate comprehensive knowledge of gastrointestinal drug pharmacology and implement this understanding in appropriate clinical decision-making contexts.
5. 5. Explore the emerging field of pharmacomicrobiomics and its potential impact on personalized therapeutics, focusing on how gut microbiota can influence drug metabolism and therapeutic outcomes.

Contents

1. **General Pharmacology**
   a) Introduction to Pharmacology. Historical milestones in pharmacology, Drug sources.
   b) Routes of drug administration, advantages and disadvantages
   c) Pharmacokinetics: Absorption (Mechanism/membrane permeability, bioavailability), distribution (mechanism, volume of distribution (Vd), plasma protein binding), metabolism (phase 1 and phase II reactions, enzyme induction/inhibition) and elimination (clearance (Cl), half-life) of drugs along with factors affecting them.
   d) Pharmacodynamics: Drug receptor interactions (Agonist, antagonist, partial agonist, inverse agonist). Receptor internalization and receptors co-localization. Definitions: Spare receptors, orphan receptors, Median lethal dose (LD50), Median effective dose (ED50), and Therapeutic Index. Efficacy vs Potency, drug tolerance and dependence, dose-response relationships.

2. **Molecular And Cellular Pharmacology**
   a) Types of receptors: (Ligand-gated and voltage-gated ion channels, G-protein coupled receptors, Enzyme-linked receptors, and nuclear receptors).
   b) Secondary messengers
   c) Signaling pathways as drug targets: Nuclear Factor Kappa B (NF-κB) pathway, P53 pathway, Peroxisome proliferator-activated receptor (PPAR) pathway, Glucagon-Like Peptide-1 (GLP- 1) Pathway, JAK-STAT pathway, PI3K-Akt-mTOR Pathway, MAPK/ERK Pathway.

3. **Drugs Acting on Autonomic Nervous System (ANS):**
   a) Sympathetic agonists and antagonists
   b) Parasympathetic agonists (Direct and indirect acting), and antagonists
   c) Ganglion stimulants and Ganglion blockers
   d) Neuromuscular Blockers

4. **Drugs Acting on Gastrointestinal Tract:**
   a) Emetic and anti-emetics
   b) Laxatives, cathartics, and constipation therapy
   c) Anti-diarrheal agents
   d) Treatment of Peptic & duodenal ulcer
   e) Drug treatment of chronic inflammatory bowel diseases
   f) Drugs affecting bile flow and Cholelithiasis

5. **Pharmaco-microbiomics**
   a) Introduction to pharmaco-microbiomics and relationship with precision medicine

6. **Drugs acting on Blood**

Note:

1. Briefly introduce banned/obsolete drugs, focusing on withdrawal reasons and key examples.
2. Emphasize class-wide drug actions and highlight only major individual drug differences.
3. Include newly approved clinically relevant drugs while excluding therapeutically insignificant ones.
4. Select prototype drugs from latest authoritative textbooks representing class characteristics.
5. Avoid repetitive teaching - provide overviews for previously covered drug classes.

Recommended Reading

1. Anthony Trevor, Bertram Katzung, Susan Masters, Marieke Knuidering-Hall. Katzung & Trevor's Pharmacology Examination and Board Review, 11th Edition, 2015. Lange Medical Books.
2. Bertram G. Katzung, Susan Masters, Anthony Trevor. Basic and Clinical Pharmacology, 13th Edition, 2014. A Lange Medical Book. London.
3. David E. Golan, Armen H. Tashjian, Jr. Ehrin J. Armstrong, April W. Armstrong. Principles of Pharmacology "The Pathophysiologic Basis of Drug Therapy". 3rd Edition (2011). Lippincott Williams & Wilkins.
4. Goodman & Gilman's. The Pharmacological Basis of Therapeutics 12th Edition, 2010. McGraw-Hill, USA.
5. Rang H.P., Dale M.M. Rang & Dale's Pharmacology, 8th Edition, 2015. Churchill Living Stone, England.

PHL-407 | Cr. Hrs. 1

Pharmacology and Therapeutics (Lab) -I

Course Learning Outcomes

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

1. Explain the purpose of pharmacological experiments and apply basic research methods and ethical principles in laboratory animal handling.
2. Prepare physiological salt solutions (Ringer's, Tyrode's, Kreb's) for isolated tissue and organ studies.

3. Demonstrate and analyze stimulant drug effects (acetylcholine, barium chloride) on rabbit intestinal motility.
4. Demonstrate and analyze depressant drug effects (atropine) on rabbit intestinal movements.
5. Evaluate intestinal contractile responses to altered potassium concentrations
6. Induce diarrhea by castor oil in mice and assess the antidiarrheal activity of loperamide.
7. Investigate autonomic drug effects on the rabbit eye, including pupillary and accommodation responses to phenylephrine, homatropine, and pilocarpine.

Contents

1. Understand purpose of pharmacological experiments, research methods in pharmacology and experimental design
2. Develop proper laboratory animal handling techniques for rats, mice, and guinea pigs following institutional ethical guidelines.
3. Prepare Ringer's solution for physiological studies
4. Prepare Tyrode's solution for intestinal smooth muscle experiments
5. Prepare Kreb's solution for isolated tissue experiments
6. Demonstrate stimulant drug effects (acetylcholine, barium chloride) on rabbit intestine
7. Demonstrate depressant drug effects (atropine) on rabbit intestine
8. Analyze high potassium (80 mM)-induced contractions in rabbit intestine
9. Analyze low potassium (20 mM)-induced contractions in rabbit intestine
10. Induce and observe castor oil-induced diarrhea in mice
11. Evaluate loperamide's antidiarrheal effects on castor oil-induced diarrhea in mice
12. Investigate phenylephrine's effects on rabbit eye (pupil size/iris muscles)
13. Investigate homatropine's effects on rabbit eye (cycloplegia/mydriasis)
14. Investigate pilocarpine's effects on rabbit eye (miosis/ciliary muscle contraction)

Note: A minimum of 10 practicals will be conducted.

Recommended Reading

1. Bikash M, Ajay P. Practical Manual of Experimental and Clinical Pharmacology.1st edition, 2010, Jaypee Brothers Medical Publishers.
2. K.K. Pillai. Experimental Pharmacology. 2012, CBS Publisher.
3. Mark A. Suckow, Karla A. Stevens, Ronald P. Wilson. "The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents". 1st edition, 2012, Academic Press.

PHL-413 | Cr. Hrs. 2

Pathology

Course Learning Outcomes

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

1. Define and differentiate core pathological terms (e.g., ischemia, necrosis, neoplasia) and explain the mechanisms of inflammation, cellular injury, adaptation, and repair.
2. Describe the pathogenesis, morphological changes, and clinical implications of common diseases affecting major organ systems (cardiovascular, nervous, gastrointestinal, endocrine/metabolic).
3. Compare benign and malignant tumors, interpret the hallmarks of cancer, and apply the TNM classification system.
4. Correlate pathological changes with disease manifestations in key conditions (e.g., myocardial infarction, diabetes, peptic ulcers, neurodegenerative disorders).

Contents

1. **General Pathology**
   Introduction to Pathology, Definition, scope, and branches of pathology. Cellular

adaptations (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia).

2. **Cellular Injury and Death**
   Causes of cell injury (hypoxia, ischemia, toxins, infections). Mechanisms: Reversible vs. irreversible injury, necrosis, apoptosis. Cellular accumulations (lipids, proteins, pigments).

3. **Inflammation and Repair.**
   Acute/chronic inflammation, chemical mediators. Wound healing, fibrosis, granulomas.

4. **Systemic Pathology**
   a) Cardiovascular Pathology. Ischemic heart disease (angina, myocardial infarction), Hypertension, heart failure, arrhythmias.
   b) Neurological Pathology. Neurodegenerative disorders (Parkinson's, Alzheimer's), epilepsy, stroke.
   c) Gastrointestinal Pathology. Peptic ulcer disease (gastric/duodenal ulcers). Inflammatory bowel disease, liver cirrhosis.
   d) Endocrine/Metabolic Pathology. Diabetes mellitus (types, complications) and Gout.

5. **Cancer**
   Benign vs. malignant, carcinoma vs. sarcoma. Hallmarks of cancer, metastasis. TNM staging, grading. Definitions of common tumors, examples: Lipoma, adenoma, melanoma, leukemia, and lymphoma etc.

Recommended Reading

1. David E. Golan, Armen H. Tashjian, Jr. Ehrin J. Armstrong, April W. Armstrong. Principles of Pharmacology. "The Pathophysiologic Basis of Drug Therapy". 3rd Edition (2011).
2. Martin Gwent Lewis and Thomas K. Barton. Appleton & Lange's Review of General Pathology. 4th Edition, 2002, Prentince Hall International Inc.
3. Michael D. Randall and Karen E Neil. Disease Management, 2nd Edition, 2008.
4. Ramzi S. Cotran, Vinay Kumar & Stanley L. Robbins. Robbins & Cotran Pathologic Basis of Disease. 9th Edition, 2014. W.B. Saunders Company, Philadelphia.
5. Russell J. Greene and Norman D. Harris. Pathology and Therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice.3rd edition, 2008. Chapman & Hall, London.

PHL-415 | Cr. Hrs. 1

Pathology (Lab)

Course Learning Outcomes

By the end of the course, students will be able to:

1. Interpret a histopathology report showing features of chronic inflammation with comparative analysis of acute inflammatory response.
2. Interpret a pathology report of a benign vs. malignant neoplasm with reference to histological differentiation and invasion markers.
3. Interpret a lymph node biopsy report showing granulomatous inflammation, identifying diagnostic clues and pathological relevance.
4. Interpret a histopathology report suggestive of dysplasia and explain its relevance in pre-cancerous lesions.
5. Interpret a tumor staging and grading report (TNM system) and explain its clinical pathological implications.
6. Interpret a pathology report describing fatty change in liver tissue with reference to reversible cellular injury.
7. Interpret a pathological hematology report suggestive of anemia and compare it with a normal profile.
8. Interpret a gastric biopsy report in peptic ulcer disease with emphasis on inflammatory and structural changes.

9. Interpret a liver biopsy report showing features of cirrhosis with reference to fibrosis and nodular regeneration.
10. Interpret a breast lump biopsy report by differentiating fibroadenoma from invasive ductal carcinoma.
11. Interpret a prostate biopsy report in suspected prostatic hyperplasia or adenocarcinoma.
12. Interpret an oral mucosal biopsy report showing leukoplakia or squamous cell carcinoma.
13. Interpret a pathological report in a case of suspected gout and its comparison with normal reference parameters.

Contents

1. Histopathological Evaluation of Chronic vs. Acute Inflammation
2. Comparative Histopathology of Benign and Malignant Neoplasms
3. Assessment of Granulomatous Inflammation in Lymph Node Biopsy
4. Histopathological Identification of Dysplasia in Pre-Cancerous Lesions
5. Interpretation of Tumor Staging and Grading Using the TNM System
6. Microscopic Analysis of Fatty Change as a Reversible Cellular Injury
7. Pathological Hematology Assessment of Anemia vs. Normal Profile
8. Histopathological Examination of Gastric Biopsy in Peptic Ulcer Disease
9. Liver Biopsy Interpretation in Cirrhosis: Fibrosis and Nodular Regeneration
10. Differential Diagnosis of Breast Lump: Fibroadenoma vs. Invasive Ductal Carcinoma
11. Histopathological Evaluation of Prostatic Hyperplasia and Adenocarcinoma
12. Assessment of Oral Mucosal Biopsy: Leukoplakia vs. Squamous Cell Carcinoma
13. Pathology Report Interpretation in Suspected Gout with Biochemical Correlation

Note: A minimum of 10 practicals should be conducted

Recommended Reading

1. Cross, S. S. (2018). Underwood's pathology: A clinical approach (6th ed.). Elsevier
2. Goldblum, J. R., Lamps, L. W., McKenney, J. K., & Myers, J. L. (2018). Rosai and Ackerman's surgical pathology (11th ed.). Elsevier.
3. Greene, R. J., & Harris, N. D. (2008). Pathology and therapeutics for pharmacists (3rd ed.). Pharmaceutical Press.
4. Kumar, V., Abbas, A. K., & Aster, J. C. (2020). Robbins and Cotran pathologic basis of disease (10th ed.). Elsevier.
5. Kumar, V., Abbas, A. K., Aster, J. C. (2017). Robbins basic pathology (10th ed.). Elsevier - Health Sciences Division
6. Reisner, H. M., & Rubin, E. (2014). Essentials of Rubin's pathology (6th ed.). Wolters Kluwer Health/Lippincott Williams & Wilkins.
7. Sattar, H. A. (2014). Fundamentals of pathology: Medical course and step 1 review (2nd ed.). Pathoma
8. World Health Organization. (2019). WHO classification of tumours (5th ed.). International Agency for Research on Cancer.

PHL-505 | Cr. Hrs. 3

Pharmacology & Therapeutics-III

Course Learning Outcomes

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

1. Analyze the pharmacology of antimicrobial and anticancer agents, interpret WHO and DRAP treatment guidelines, and apply this knowledge to optimize therapeutic regimens in clinical practice.
2. Evaluate the mechanisms of anti-inflammatory and anti-rheumatic drugs, implement ACR guidelines for gout and rheumatoid arthritis management, and design evidence-based treatment plans.
3. Demonstrate knowledge of monoclonal antibodies and immunomodulators, and utilize these therapies according to current clinical protocols in autoimmune and neoplastic disorders.

Contents

1. **Chemotherapy**
   a) Basic principles of chemotherapy
   b) Anti-bacterials:
   • Cell wall synthesis inhibitors (β-lactam antibiotics and glycopeptide antibiotics)
   • Protein synthesis inhibitors
   • DNA gyrase inhibitors
   • Anti-folate drugs
   • Antimycobacterial drugs
   c) Anti-fungals
   d) Anti-virals
   e) Anti-protozoals
   f) Cancer chemotherapeutic drugs
   g) Overview of the guidelines on responsible use of antimicrobials in human health by Drug Regulatory Authority of Pakistan

2. **Anti-Inflammatory and Anti-Rheumatic Drugs:**
   a) Nonsteroidal anti-inflammatory drugs
   b) Disease modifying anti-rheumatic drugs
   c) Non-opioid analgesics
   d) Drugs used in the treatment of gout.
   e) Overview of the guidelines for the management of Gout and Rheumatoid Arthritis from American College of Rheumatology

3. **Immunopharmacology**
   Pharmacology of immuno-suppressants, stimulants, and biosimilars:
   a) Anti-inflammatory monoclonal antibodies: cytokine inhibitors, T-cell activation inhibitors
   b) Asthma therapy: anti-IgE monoclonal antibodies
   c) Anti-tumor monoclonal antibodies
   d) Other monoclonal antibodies: Against Rabies and Tetanus toxins, Intravenous Immuno globulin (IVIg)
   e) Immunomodulation therapy: Interferons

   Note:
   1. Briefly introduce banned/obsolete drugs, focusing on withdrawal reasons and key examples.
   2. Emphasize class-wide drug actions and highlight only major individual drug differences.
   3. Include newly approved clinically relevant drugs while excluding therapeutically insignificant ones.
   4. Select prototype drugs from latest authoritative textbooks representing class characteristics.
   5. Avoid repetitive teaching - provide overviews for previously covered drug classes.
   6. There should be emphasis on therapeutics and while consulting clinical practice guidelines, emphasis should be on pharmacological and/or therapeutic treatment guidelines. Latest and updated guidelines should be discussed. Appropriate references and links are given in list of references along with teaching tips at end of each relevant reference.

Recommended Reading

1. Anthony Trevor, Bertram Katzung, Susan Masters, Marieke Knuidering-Hall. Katzung & Trevor's Pharmacology Examination and Board Review, 14th Edition, 2015. Lange Medical Books.
2. Bertram G. Katzung, Susan Masters, Anthony Trevor. Basic and Clinical Pharmacology, 13th Edition, 2014. A Lange Medical Book. London.
3. David E. Golan, Armen H. Tashjian, Jr. Ehrin J. Armstrong, April W. Armstrong. Principles of Pharmacology "The Pathophysiologic Basis of Drug Therapy". 3rd Edition (2011). Lippincott Williams & Wilkins.
4. Goodman & Gilman's. The Pharmacological Basis of Therapeutics 12th Edition, 2010. McGraw-Hill, USA.
5. Rang H.P., Dale M.M. Rang & Dale's Pharmacology, 8th Edition, 2015. Churchill Living Stone, England.

PHL-507 | Cr. Hrs. 1

Pharmacology & Therapeutics (Lab)-III

Course Learning Outcomes

By the end of this course, student will be able to:

1. Evaluate the analgesic effect of diclofenac using the acetic acid-induced writhing test in mice.
2. Assess the analgesic effect of pentazocine using the acetic acid-induced writhing test in mice.
3. Examine the analgesic effect of diclofenac using the hot plate method in mice.
4. Investigate the analgesic effect of pentazocine using the hot plate method in mice.
5. Determine the analgesic effect of diclofenac using the tail immersion test in mice.
6. Analyze the anti-inflammatory activity of aspirin through protein denaturation assay.
7. Measure the antioxidant activity of diclofenac using DPPH (2,2-Diphenyl-1-picrylhydrazyl) assay.
8. Evaluate the anti-inflammatory activity of naproxen in a carrageenan-induced paw edema model in rats.
9. Discuss clinical case studies involving monoclonal antibodies for rabies treatment.
10. Review clinical case studies of monoclonal antibodies against tetanus toxins.
11. Examine clinical case studies of IVIg application for immune modulation.
12. Analyze clinical case studies of anti-IgE monoclonal antibodies in asthma treatment.
13. Assess patient case studies to evaluate appropriate antibiotic prescription practices in clinical settings.

Contents

1. Analgesic Evaluation of Diclofenac Using the Acetic Acid–Induced Writhing Test in Mice
2: Analgesic Evaluation of Pentazocine Using the Acetic Acid–Induced Writhing Test in Mice
3: Analgesic Assessment of Diclofenac Using the Hot Plate Method in Mice
4: Analgesic Assessment of Pentazocine Using the Hot Plate Method in Mice
5: Analgesic Evaluation of Diclofenac Using the Tail Immersion Test in Mice
6: Anti-Inflammatory Activity of Aspirin Using Protein Denaturation Assay
7: Antioxidant Activity Measurement of Diclofenac Using the DPPH Radical Scavenging Assay
8: Anti-Inflammatory Evaluation of Naproxen in Carrageenan-Induced Paw Edema in Rats
9: Case Study Analysis: Monoclonal Antibodies in Rabies Treatment
10: Case Study Analysis: Monoclonal Antibodies Against Tetanus Toxins
11: Case Study Review: Clinical Applications of Intravenous Immunoglobulin (IVIg)
12: Case Study Analysis: Anti-IgE Monoclonal Antibodies in Asthma Management
13: Case Study Evaluation of Rational Antibiotic Prescription Practices

Note: A minimum of 10 practicals will be conducted

Recommended Reading

1. Bikash M, Ajay P. Practical Manual of Experimental and Clinical Pharmacology.1st edition, 2010, Jaypee Brothers Medical Publishers.
2. K.K. Pillai. Experimental Pharmacology. 2012, CBS Publisher.
3. Mark A. Suckow, Karla A. Stevens, Ronald P. Wilson. "The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents". 1st edition, 2012, Academic Press.

PHL-519 | Cr. Hrs. 1

Fehm-e-Quran-II

Course Learning Outcomes

By the end of this course, students will be able to:

1. Comprehend and translate Quranic sentences with a variety of verb forms and tenses.
2. Analyze sentence components including verb conjugations, pronouns, and grammatical structures.
3. Apply understanding of advanced linguistic features to extract meaning from longer verses.
4. Strengthen comprehension of Quranic themes through grammatical and contextual study.
5. Improve independent reading and understanding of Quranic Arabic.
6. Understand up to 50–60% of each page of the Quran used in this course.

Contents

A continuation of Fehm ul Quran I, this course deepens students' understanding of Quranic Arabic by introducing complex grammatical forms, verb usage, sentence structure variations, and Quranic themes. Emphasis is placed on practical translation exercises, verb tenses, verb morphology, and linguistic analysis of longer Quranic passages.

Topics include:

- Verb forms and tenses (past, present, imperative)
- Verb conjugation (active/passive voice, duals, plurals)
- Sentence transformation (from nominal to verbal forms)
- Compound and complex sentence structures
- Usage of advanced particles and conjunctions
- Translation and tafsir-based understanding of selected longer verses
- Continued vocabulary building through Quranic text

Recommended Reading

1. Arabic English Dictionary of Qur'anic Usage El Said M. Badawi & M. A. Abdel Haleem.
2. Al Mufradat fi Gharib al Quran Al Raghib al Isfahani.
3. Muallim Ul Quran (Volumes 1 3) Dr. Ubaid ur Rahman Bashir.
4. Learning Quranic Arabic for Complete Beginners: A Step-by-Step Self Teaching Guide to the Arabic Language of the Quran Ikram Hawramani.
5. Essentials of Grammar for Learning Quranic Language Zahoor Ahmed.
6. Qur'anic Language Made Easy Hafiza Iffath Hasan.

PHL-711 | Cr. Hrs. 2

Clinical Pharmacology

Course Learning Outcomes

By the end of this course students will be able to:

1. Explain how pregnancy alters the pharmacokinetics and pharmacodynamics of drugs, and evaluate the risks of teratogenicity when selecting drug therapies.
2. Describe the pharmacokinetic and pharmacodynamic differences in infants and children, and apply this knowledge to ensure rational and safe pediatric drug use.
3. Analyze the considerations for drug use during lactation, including the potential for drug transfer through breast milk and its effects on infants.
4. Discuss age-related changes in drug absorption, distribution, metabolism, and excretion, and

adjust drug therapy appropriately in geriatric patients.
5. Evaluate how co-morbid conditions such as hepatic impairment, renal dysfunction, and diabetes affect drug response, and modify treatment regimens accordingly.

Contents

1. **Clinical Pharmacology in pregnancy**
   a. Effects of pregnancy on the Pharmacokinetics of drugs
   b. Effects of pregnancy on the Pharmacodynamics of drugs
   c. Teratogenic drug actions

2. **Pediatric Clinical Pharmacology**
   a. Pharmacokinetic considerations in infants and children
   b. Pharmacodynamic considerations in infants and children
   c. Drug use during lactation

3. **Geriatric Clinical Pharmacology**
   a. Pharmacokinetic changes associated with aging
   b. Pharmacodynamic changes associated with aging

4. **Overview of the effects of co-morbidities on drug response**
   a. Effects of hepatic and renal diseases on drug response
   b. Effects of diabetes and environmental factors on drug response

Recommended Reading

1. Brunton, L. L., & Knollmann, B. C. (Eds.). (2023). Goodman & Gilman's: The pharmacological basis of therapeutics (14th ed.). McGraw-Hill Education.
2. Cicalese, P. A. (2020). Pharmacotherapy for complex patients: A case-based approach. Springer.
3. Katzung, B. G., & Vanderah, T. W. (Eds.). (2024). Basic & clinical pharmacology (16th ed.). McGraw Hill.
4. Nahata, M. C., & Hipple, T. F. (2009). Pediatric drug formulations (6th ed.). American Pharmacists
5. Association.
6. Noble, S. (2022). Drugs in pregnancy and lactation: A reference guide to fetal and neonatal risk (12th ed.). Wolters Kluwer.
7. Rowe, J. W., & Fulmer, T. (Eds.). (2018). Clinical geriatrics (3rd ed.). Wiley-Blackwell.
8. Shargel, L., Wu-Pong, S., & Yu, A. B. C. (2012). Applied biopharmaceutics and pharmacokinetics (7th ed.). McGraw-Hill Education.
9. Talbert, R. L., DiPiro, J. T., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (2022). Pharmacotherapy: A pathophysiologic approach (11th ed.). McGraw-Hill Education.

PHL-713 | Cr. Hrs. 1

Clinical Pharmacology (Lab)

Course Learning Outcomes

By the end of this course students will be able to discuss and analyze following real-life Clinical Pharmacology cases:

A. Pregnancy

1. Case Discussion: UTI in a pregnant woman during first trimester
   • Discuss selection of antibiotics considering fetal safety and teratogenic risks.
2. Case Discussion: Nausea and vomiting in early pregnancy
   • Evaluate pharmacological treatment options, focusing on safety during organogenesis.
3. Case Discussion: Hypertension in a pregnant woman at 24 weeks gestation, Eclampsia & Preeclampsia
   • Identify antihypertensive drugs that are safe in mid-pregnancy and avoid teratogenic or

fetotoxic agents, Management of Eclampsia & Preeclampsia.
4. Case Discussion: Gestational diabetes diagnosed at 28 weeks of pregnancy
   • Discuss appropriate glycemic targets and selection of safe antidiabetic agents during pregnancy.

B. Lactation
1. Case Discussion: Mother with postpartum infection needing antibiotic therapy
   • Analyze which antibiotics are safe during breastfeeding and how to minimize infant drug exposure.
2. Case Discussion: Postpartum mother on antidepressants
   • Discuss antidepressant safety during lactation and the risk-benefit analysis for mother and infant.

C. Pediatrics
1. Case Discussion: Febrile seizures in a 2-year-old child
2. Evaluate appropriate antipyretic and anticonvulsant use, considering age-specific dosing and safety.
3. Case Discussion: Asthma exacerbation in a 6-year-old child
4. Discuss age-appropriate bronchodilator and steroid use in acute and maintenance therapy.
5. Case Discussion: Antibiotic use in acute otitis media in children
6. Identify appropriate empirical antibiotic therapy and the importance of avoiding overuse.

D. Geriatrics
1. Case Discussion: Polypharmacy in a 72-year-old patient with diabetes, hypertension, and osteoarthritis
2. Discuss risk of drug interactions, inappropriate medications, and strategies to reduce pill burden.
3. Case Discussion: Fall risk in an elderly patient on benzodiazepines
4. Identify safer alternatives and discuss age-related pharmacodynamic changes increasing fall risk.

E. Dose calculation for special patients
1. Case Discussion: Dose calculation in special population i.e Renal Failure, Liver Failure, pediatrics, geriatrics etc.

F. Comorbidities and Drug Safety
1. Case Discussion: NSAID use in a patient with chronic kidney disease
2. Discuss renal safety profile of NSAIDs and suggest safer analgesic alternatives.
3. Case Discussion: Antibiotic prescribing in a diabetic patient with foot infection
4. Explore antibiotic selection, tissue penetration, and risks related to impaired immunity.

Contents

Alternatives
14. Case Study: Antibiotic Prescribing in Diabetic Foot Infection – Tissue Penetration and Immune Considerations

Note: A minimum of 10 practicals should be conducted

Recommended Reading

1. Arthur J. Atkinson Jr, Shiew-Mei Huang, Juan J.L. Lertora, Sanford P. Markey. Principles of Clinical Pharma cology. 3rd edition, 2012, Academic Press.
2. P.V. Rataboli. Clinical Pharmacology and Rational Therapeutics, 2nd edition, 2010, Ane Books Pvt Ltd.
3. Gerard A. McKay, Matthew R. Walters. Clinical Pharmacology and Therapeutics .9th edition, 2013, Wiley Blackwell.
4. Mary Anne Koda Kimble. Koda-kimble & Young's Applied Therapeutics: "The Clinical Use of Drugs" 10th Edition, 2012. Lippincott Williams & Wilkins USA.
5. Roger Walker and Cate Whittlesea. Clinical Pharmacy and Therapeutics, 5th Edition (2011).

Pharm. D. Courses – Outline
Second Semester

PHL-314 | Cr. Hrs. 2
Anatomy & Histology

Course Learning Outcomes

At the end of this course the student 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.

Contents

1. **The Thorax**
   The thoracic cage, the thoracic vertebrae, the ribs, sternum, diaphragm, lobes and fissures of lungs, trachea, bronchi, pharynx, larynx

2. **The Heart**
   Anterior and posterior aspects of the heart, the coronary arteries and veins, heart chambers, mediastinum

3. **The Abdominal Cavity**
   a. Positions of liver, spleen, gall bladder, pancreas, stomach and kidney in the abdominal cavity.
   b. Gross anatomy of stomach, intestine, liver, spleen, gall bladder, pancreas, and kidney
   c. The portal system of veins, the biliary duct system

4. **The Urinary System**
   Gross anatomy of the ureter, the bladder, the urethra, scrotum, testis

5. **Upper and Lower Limb**
   Gross anatomy of the bones and joints of upper and lower limbs

6. **Nervous System**
   Gross anatomy of spinal cord and brain, names of the cranial nerves and their specific functions.

7. **Eye and Ear**
   Gross anatomy of eye and ear

8. **Histology**
   a. Overview of histological techniques like tissue fixation, embedding, sectioning, staining, and microscopy.
   b. Pharmacological relevance of histology

Recommended Reading

1. Agur, A. M. R., & Dalley, A. F., II. (2024). Moore's Essential Clinical Anatomy (7th ed.). Lippincott Williams & Wilkins.
2. Chung, K. W., Chung, H. M., & Halliday, N. L. (2015). Gross anatomy (8th ed.). Lippincott Williams & Wilkins
3. Dalley, A. F., II, & Agur, A. M. R. (2023). Moore's Clinically Oriented Anatomy (9th ed.). Lippincott Williams & Wilkins.
4. Drake, R. L., Vogl, A. W., & Mitchell, A. W. M. (2023). Gray's Anatomy for Students (5th ed.). Elsevier.
5. Ellis, H., & Mahadevan, V. (2010). Clinical anatomy: Applied anatomy for students and junior doctors (10th ed.). Wiley-Blackwell.
6. Gartner, L. P., & Lee, L. M. J. (2023). Gartner & Hiatt's Atlas and Text of Histology (8th ed.). Lippincott Williams & Wilkins.
7. Morton, D. A., Foreman, K. B., & Albertine, K. H. (2011). The big picture: Gross anatomy. McGraw-Hill.
8. Ross, M. H., & Pawlina, W. (2023). Histology: A Text and Atlas with Correlated Cell and Molecular Biology (9th ed.). Lippincott Williams & Wilkins.
9. Standring, S. (Ed.). (2020). Gray's anatomy: The anatomical basis of clinical practice (42nd ed.). Elsevier.

PHL-316 | Cr. Hrs. 1

Anatomy and Histology (Lab)

Course Learning Outcomes

By the end of this course, students will be able to:

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).

Contents

1. Study of Thoracic Anatomy: Thoracic Cage, Diaphragm, and Lung Structures
2. Examination of Cardiac Morphology and Associated Vasculature
3. Identification of Abdominal Organs Using Anatomical Models
4. Observation of Urinary System Components: Kidney, Ureter, Bladder, and Urethra
5. Anatomical Study of Male and Female Reproductive Systems
6. Gross Anatomy of the Upper Limb: Bones and Joints
7. Gross Anatomy of the Lower Limb: Bones and Joints
8. Gross Anatomy of the Brain: Major Regions and Ventricular System
9. Study of Spinal Cord Anatomy and Vertebral Structures
10. Identification of the Anatomical Structures of the Human Eye and Ear
11. Tissue Fixation of Rat Liver and Kidney Using 10% Neutral Buffered Formalin
12. Microscopic Identification of Major Histological Tissues and Organ Systems

Note:
- The practicals shall be conducted using detailed anatomical models.
- A minimum of 10 practicals should be conducted.

Recommended Reading

1. Agur, A. M. R., & Dalley, A. F., II. (2024). Moore's Essential Clinical Anatomy (7th ed.). Lippincott Williams & Wilkins.
2. Chung, K. W., Chung, H. M., & Halliday, N. L. (2015). Gross anatomy (8th ed.). Lippincott Williams & Wilkins
3. Dalley, A. F., II, & Agur, A. M. R. (2023). Moore's Clinically Oriented Anatomy (9th ed.). Lippincott Williams & Wilkins.
4. Drake, R. L., Vogl, A. W., & Mitchell, A. W. M. (2023). Gray's Anatomy for Students (5th ed.). Elsevier.
5. Ellis, H., & Mahadevan, V. (2010). Clinical anatomy: Applied anatomy for students and junior doctors (10th ed.). Wiley-Blackwell.
6. Gartner, L. P., & Lee, L. M. J. (2023). Gartner & Hiatt's Atlas and Text of Histology (8th ed.). Lippincott Williams & Wilkins.
7. Morton, D. A., Foreman, K. B., & Albertine, K. H. (2011). The big picture: Gross anatomy. McGraw-Hill.
8. Ross, M. H., & Pawlina, W. (2023). Histology: A Text and Atlas with Correlated Cell and Molecular Biology (9th ed.). Lippincott Williams & Wilkins.
9. Standring, S. (Ed.). (2020). Gray's anatomy: The anatomical basis of clinical practice (42nd ed.). Elsevier.

PHL-318 | Cr. Hrs. 3

Physiology-II

Course Learning Outcomes

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

1. Describe how the nervous system controls body functions, including how neurons work, how action potentials and synapse function, the role of neurotransmitters and sensory receptors, and the structure and function of the central and autonomic nervous systems.
2. Explain how the respiratory system works, including gas exchange, breathing control, and the different lung volumes and capacities.
3. Describe kidney function and urine formation, and explain how the body maintains fluid, electrolyte, and acid-base balance.
4. Explain the physiology of the male and female reproductive systems, including gamete formation, the menstrual cycle, and stages such as puberty, pregnancy, and menopause.

Contents

1. **Neural Control Mechanisms**
   functional classes of neurons, voltage-gated sodium and potassium channels, resting membrane potential, initiation and propagation of action potential, refractory period, all or nothing principle, synapses, types of synapses, physiological anatomy of synapses, excitatory and inhibitory receptors in the postsynaptic membrane, excitatory and inhibitory postsynaptic potentials, classification of sensory receptors, neurotransmitters and neuro modulators.

2. **Central Nervous System**
   Physiological anatomy of brain and spinal cord, blood-brain barrier, functions of cerebrospinal fluid, types of sleep.

3. **Autonomic Nervous System**
   Physiological anatomy of sympathetic and parasympathetic nervous system, pre-ganglionic and post-ganglionic neurons, synthesis and secretion of acetylcholine and 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

4. **Respiratory Physiology**
   Physiological anatomy of lungs, mechanism of inspiration and expiration, definitions of various lung volumes and capacities, 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, regulation of respiration, pulmonary edema, pleural effusion, non-respiratory functions of the Lungs.

5. **Renal Physiology**
   Physiological anatomy of kidney and nephron, Functions of the kidney, Urine formation, glomerular filtration, glomerular filtration rate (GFR), mechanisms of tubular reabsorption and secretion, formation of dilute and concentrated urine, micturition, buffering of H+ ion, renal sodium regulation, renal potassium regulation, renal water regulation.

6. **Endocrine and Reproductive Physiology**
   Physiological roles of hormones secreted from major endocrine glands (pituitary, thyroid, adrenal, and pancreas), along with reproductive physiology including gametogenesis, menstrual cycle regulation, and life-stage transitions.

Recommended Reading

1. Arthur C. Guyton and John E. Hall. Textbook of Medical Physiology. 13th Edition, 2015, W.B. Saunders, Philadelphia.
2. Barbara Young, Philip Woodford, Geraldine o' Dowd Wheater's Functional Histology: A Text and Colour Atlas. 6th Edition, 2013.
3. Douglas F. Paulsen. Basic Histology: Examination and Board Review. 5th edition, 2010, Prentice Hall Internal Inc.
4. Frederic H. Martini. Fundamentals of Anatomy and Physiology. 10th Edition, 2014, Prentice Hall, New Jersey.
5. Gerard J. Tortora & Bryan Derrickson. Principles of Anatomy and Physiology. 14th Edition, 2013, John Wiley & Sons, New York.

PHL-320 | Cr. Hrs. 1

Physiology (Lab) II

Course Learning Outcomes

1. Students will learn to perform essential hematological tests, including hemoglobin estimation, ESR measurement, RBC counting, bleeding time, and coagulation time.
2. Students will learn to determine ABO and Rh blood groups using antigen–antibody agglutination techniques and will learn the underlying principles of blood typing.

3. Students will learn to measure key respiratory parameters such as tidal volume, inspiratory reserve volume, expiratory reserve volume, and vital capacity, and will learn their relevance to pulmonary function.
4. Students will learn to analyze respiratory rate and oxygen saturation changes under resting and post-exercise conditions
5. Students will learn the correct technique for nebulization using normal saline and will learn its purpose in respiratory care.
6. Students will learn to perform cardiopulmonary resuscitation (CPR) using a training manikin and will learn the essential steps of basic life support.
7. Students will learn the importance of vector control strategies in preventing the spread of dengue fever.
8. Students will learn to identify normal and abnormal heart and lung sounds using pre-recorded audio.

Contents

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

Note:
A basic life support (BLS) workshop shall be mandatory to attend as part of Physiology-II practical. The Institute/University may issue a certificate after successful completion of workshop. A minimum of 10 practicals should be conducted

Recommended Reading

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

PHL-322 | Cr. Hrs. 2

Islamic Studies

Course Learning Outcomes

By the end of this course, students will:

1. Learn to explain the need for religion and the role of Wahi (Divine revelation) in guiding human knowledge and actions.
2. Learn to describe the Islamic concept of life, including the universe, the position of humankind, and the purpose of human activities.

3. Learn to identify and explain core Islamic beliefs (Aqaid) such as Tawhid, angels, prophethood, revealed books, and the Hereafter, and their influence on character and society.
4. Learn to compare and analyze Islamic worship practices (Ibadat) including Salat, Zakat, Sawm, and Hajj, and their ethical, social, and economic significance.
5. Learn to explain the ideology of Pakistan and the historical movements leading to its creation, including the role of Islamic principles in governance and constitution.
6. Learn to discuss Islamic moral values and their application in personal conduct and societal development.

Contents

1. **The Need for Religion**
   A critical analysis of the sources of human knowledge and the importance of Wahi (Divine revelation).

2. **Islamic Concept of Life**
   Islamic concept of universe, the position of mankind, the earth, the goal for men's activities.

3. **Islamic Beliefs**
   Islam and aqida, the role of iman in character building and in the development of civilization.
   Aqida-tawhid (belief in unity of God), its details and its impact on character.
   Iman bil Malaikah (belief in angels).
   Aqida risalat (belief in prophethood), its details and its importance in the development of I slamic civilization, the distinguishing features of Muhammad (PBUH) Prophethood, the doctrine of the last prophet.
   Iman bil kutub (Belief in the revealed books).
   Aqida Akhrat (Belief in the life hereafter), its details, quranic style of arguments on the life hereafter.
   The impact of Aqida Akhrat on individual and society.
   A comparison and Islamic concept of Ibadat with other religions.
   Salat (Prayer), Zakat, its philosophy, rates and minimum zakat amount, its impact on economy.
   Sawm (Fasting), Hajj (Pilgrimage), Manasik and its importance.

4. **Pakistan Studies**
   Ideology of Pakistan and its basic elements, two-nation theory; Aims and objectives for the creation of Pakistan; The Khilafat Movement; The struggle for Islamic System with special reference to the Constitution of Pakistan 1973; The common problems of Muslim countries and their solutions.

5. **Islamic Moral Values**
   Philosophy of morality in Islamic moral values.

Recommended Reading

1. Kursheed Ahmed – Islam ka Nazariya Hayat
2. Shiblee Naumani / Syed Suleman Nadvi – Seerat-un-Nabi (SAWW) Jild-e-Kamil.

PHL-410 | Cr. Hrs. 3

Pharmacology & Therapeutics-II

Course Learning Outcomes

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

1. Analyse pharmacogenomic principles and their clinical applications, evaluate ethical implications, and interpret the FDA Table of Pharmacogenetic Associations in therapeutic decision-making.
2. Evaluate cardiovascular drug mechanisms, co-relate international treatment guidelines (ACC/AHA/ESH), and implement evidence-based pharmacological interventions in clinical practice.

3. Demonstrate endocrine drug pharmacology, integrate AACE diabetes management algorithms, and design appropriate therapeutic regimens for endocrine disorders.
4. Explain respiratory drug actions and utilize this knowledge to optimize treatment strategies for pulmonary conditions in clinical settings.

Contents

1. Pharmacogenomics and Pharmacogenetics
   a) Overview: DNA and its structure, chromosome, Gene, pharmacogenes, allele, genotype, phenotype, gene-drug interaction, genetic polymorphism and its types, Cytochrome P450 enzyme polymorphism, pharmacogenetics, pharmacogenomics
   b) Clinical applications of Pharmacogenomics (Concepts of personalized medicine and precision medicine, targeted therapy and its selection, predicting drug response, optimizing drug dosing, prevention of adverse drug reactions, understanding genetic mechanisms for antibiotic resistance).
   c) Gene therapy and Gene editing along with their clinical applications.
   d) Overview of FDA Table of Pharmacogenetic Associations.
   e) Ethical considerations in Pharmacogenomics

2. Drugs Acting on Cardio-Vascular System
   a) Anti-hypertensive drugs
   b) Diuretics
   c) Anti-anginal drugs
   d) Treatment of congestive heart failure
   e) Anti-arrhythmic drugs
   f) Anti-hyperlipidemic agents.
   g) Coagulants and Anti-coagulants
   h) Overview of Pharmacological treatment guidelines from European Society of Hypertension and International Society of Hypertension.
   i) Overview of Medical Therapy to Prevent Cardiovascular Events and Manage Symptoms in Clinical Practice Guidelines from American Heart Association/American College of Cardiology.

3. Drugs Affecting Endocrine Function
   a) Therapeutic agents for: Type 1 and Type 2 Diabetes Mellitus, Latent Autoimmune Diabetes in Adults (LADA), Maturity-Onset Diabetes of the Young (MODY), Includes: Insulin preparations and oral antidiabetic drugs.
   b) Corticosteroids
   c) Thyroid hormone and anti-thyroid drugs
   d) Overview of comprehensive Type 2 Diabetes Management Algorithms from American Association of Clinical
   Endocrinology
   e) Drugs acting on reproductive system: Contraceptives, Fertility drugs, Testosterone and contraception in males, erectile dysfunction and Pharmacotherapy.

4. Drugs Acting on Respiratory System:
   Anti-asthmatics, Antitussives, Pulmonary surfactants, Drugs for Pulmonary Hypertension and cystic fibrosis

Note:
1. Briefly introduce banned/obsolete drugs, focusing on withdrawal reasons and key examples.
2. Emphasize class-wide drug actions and highlight only major individual drug differences.
3. Include newly approved clinically relevant drugs while excluding therapeutically insignificant ones.
4. Select prototype drugs from latest authoritative textbooks representing class characteristics.
5. Avoid repetitive teaching - provide overviews for previously covered drug classes.
6. There should be emphasis on therapeutics and while consulting clinical practice guidelines, emphasis should be on pharmacological and/or therapeutic treatment guidelines. Latest and updated guidelines should be discussed. Appropriate references and links are given in list of references along with teaching tips at end of each relevant reference.
7. Instructors are encouraged to discuss a few selected examples form each section of FDA table of Pharmacogenetic Association to explain gene-drug interactions to students.

Recommended Reading

1. Anthony Trevor, Bertram Katzung, Susan Masters, Marieke Knuidering-Hall. Katzung & Trevor's Pharmacology Examination and Board Review, 14th Edition, 2015. Lange Medical Books.
2. Bertram G. Katzung, Susan Masters, Anthony Trevor. Basic and Clinical Pharmacology, 13th Edition, 2014. A Lange Medical Book. London.
3. David E. Golan, Armen H. Tashjian, Jr. Ehrin J. Armstrong, April W. Armstrong. Principles of Pharmacology "The Pathophysiologic Basis of Drug Therapy". 3rd Edition (2011). Lippincott Williams & Wilkins.
4. Goodman & Gilman's. The Pharmacological Basis of Therapeutics 12th Edition, 2010. McGraw-Hill, USA.
5. Rang H.P., Dale M.M. Rang & Dale's Pharmacology, 8th Edition, 2015. Churchill Living Stone, England.

PHL-412 | Cr. Hrs. 1

Pharmacology and Therapeutics (Lab) -II

Course Learning Outcomes

By the end of the course, student will be able to:

1. Demonstrate humane euthanasia procedures for rodents using AVMA-approved methods
2. Perform terminal blood collection via cardiac puncture in anesthetized rats with aseptic technique
3. Separate plasma and serum from human blood samples using standardized centrifugation protocols
4. Administer intraperitoneal injections in rodents using sterile syringes and proper restraint
5. Execute accurate oral dosing in rats/mice using calibrated gavage needles with safety monitoring
6. Practice intramuscular and subcutaneous injection techniques in rodents with dose verification
7. Perform effects of acetylcholine on frog heart.
8. Examine effects of atropine on frog heart.
9. Evaluate diuretic effects of furosemide in rats.
10. Perform diuretic effects of Hydrochlorothiazide in rats
11. Evaluate glibenclamide-induced hypoglycemia through OGTT in rats with glucose monitoring
12. Analyze metformin's glucose-lowering effects using OGTT in mice with controlled conditions
13. Understand WMA Helsinki Declaration principles for ethical human research participation
14. Understand OECD test guidelines for humane animal use in pharmacological research

Contents

1. Study of Humane Euthanasia Techniques in Rodents Using AVMA Guidelines
2. Study of Terminal Blood Collection via Cardiac Puncture in Rats
3. Study of Plasma and Serum Separation from Human Blood Using Centrifugation
4. Study of Intraperitoneal Injection Techniques in Rodents
5. Study of Oral Dosing in Rats and Mice Using Calibrated Gavage Needles
6. Study of Intramuscular and Subcutaneous Injection Techniques in Rodents
7. Study of Acetylcholine Effects on Frog Heart Function
8. Study of Atropine Effects on Frog Heart Function
9. Study of Diuretic Effects of Furosemide in Rats
10. Study of Diuretic Effects of Hydrochlorothiazide in Rats
11. Study of Glibenclamide-Induced Hypoglycemia Using OGTT in Rats
12. Study of Metformin's Glucose-Lowering Effects Using OGTT in Mice
13. Study of WMA Helsinki Declaration Principles for Ethical Human Research
14. Study of OECD Guidelines for Humane Animal Use in Pharmacological Research

Note: A minimum of 10 practicals will be conducted.

Recommended Reading

1. Bertram G. Katzung, Susan Masters, Anthony Trevor. Basic and Clinical Pharmacology, 13th Edition, 2014. A Lange Medical Book. London

2. Bikash M, Ajay P. Practical Manual of Experimental and Clinical Pharmacology.1st edition, 2010, Jaypee Brothers Medical Publishers.
3. K.K. Pillai. Experimental Pharmacology. 2012, CBS Publisher.
4. Mark A. Suckow, Karla A. Stevens, Ronald P. Wilson. "The Laboratory Rabbit, Guinea Pig, Hamster, and Other Rodents". 1st edition, 2012, Academic Press.
5. Richard A. Harvey, Michelle A Clark, Richard Finkel, Jose A. Rey , Karen Whalen . Pharmacology (Lippincott's Illustrated Reviews). 6th edition, 2014, Lippincott Williams & Wilkins.

PHL-418 | Cr. Hrs. 1

Fehm-e-Quran-I

Course Learning Outcomes

By the end of this course, students will be able to

1. Understand and translate basic Quranic words and short sentences (with and without verbs).
2. Identify and explain common Quranic grammatical forms (e.g., nouns, particles, pronouns).
3. Recognize and comprehend various sentence styles (e.g., nominal, emphatic, negative, interrogative).
4. Develop the ability to derive meanings of Quranic phrases using grammatical and linguistic clues.
5. Strengthen appreciation for Quranic linguistic styles, expressions, and idioms.
6. Understand 30–40% of each Quranic page covered in class.

Contents

This course provides foundational knowledge of Quranic Arabic with a focus on vocabulary, grammatical structure, and basic sentence patterns found in the Quran. Students will explore essential concepts like noun types, particles, pronouns, and prepositions through translation and linguistic analysis of selected Quranic phrases and verses.

Topics include:

- Quranic vocabulary development
- Noun types (proper/common, masculine/feminine, plural forms)
- Particles (operative/non-operative, emphasis, negation)
- Pronouns (personal and possessive)
- Adjective and possessive compounds
- Basic Quranic sentence structures
- Translation and interpretation of selected short Quranic passages

Recommended Reading

1. Arabic English Dictionary of Qur'anic Usage El Said M. Badawi & M. A. Abdel Haleem
2. Al Mufradat fi Gharib al Quran Al Raghib al Isfahani
3. Muallim Ul Quran (Volumes 1 3) Dr. Ubaid ur Rahman Bashir
4. Learning Quranic Arabic for Complete Beginners: A Step-by-Step Self-Teaching Guide to the Arabic Language of the Quran Ikram Hawramani
5. Essentials of Grammar for Learning Quranic Language Zahoor Ahmed
6. Qur'anic Language Made Easy Hafiza Iffath Hasan

PHL-506 | Cr. Hrs. 3

Pharmacology & Therapeutics-IV

Course Learning Outcomes

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

1. Analyze the pharmacology of CNS-acting drugs, interpret clinical guidelines from the European Federation of Neurological Societies, British Association of Pharmacology, and American Psychiatric Association (APA), and apply this knowledge to optimize neuropharmacological therapy in clinical practice.
2. Evaluate toxicological principles, select appropriate antidotes for drug poisoning and envenomation cases, and demonstrate expertise in chelation therapy pharmacology.
3. Implement artificial intelligence applications in pharmacological research, including machine learning for drug discovery and AI-driven pharmacological data analysis, to enhance therapeutic decision-making

Contents

1. Drugs Acting on Central Nervous System:
   b. Sedatives & Hypnotic
   c. Anxiolytics, antidepressants and antimanic drugs, Overview of the Practice Guideline for the Treatment of Patients with Major Depressive Disorder from American Psychiatric Association.
   d. Antipsychotics, Overview of the Evidence-based guidelines for treating bipolar disorder from British Association of Psychopharmacology.
   e. Antiepileptics, Overview of the Pharmacological recommendations in guidelines of European Federation of Neurological Societies for the management of status epilepticus in adults from.
   f. Antiparkinsonian and drug used in other neurodegenerative diseases, Overview of the guidelines on Therapeutic Management of Parkinson's disease from European Federation of Neurological Societies.
   g. Opioid analgesics
   h. Brief concepts of psychedelics and psychedelic pharmacy
   i. Neurosteroids
   j. Anesthetics: General and local

2. Toxicology
   a) Brief and Basic concepts of Genotoxicity and DNA repair, Carcinogenicity, Reproductive toxicity, Teratogenicity, Occupational toxicology, Forensic toxicology, Environmental toxicology, Exposome Pharmacology, Mitochondrial toxicity, and toxicogenomics
   b) Antidotes of drug poisoning
   c) Anti-venoms
   d) Pharmacology of chelators: Dimercaprol, Edetate Calcium disodium, Pencillamine, Unithol, Defroxamine, Deferasirox, Prussian blue.

3. Applications of Artificial Intelligence in Pharmacology
   a) Use of AI to predict drug-target interactions.
   b) Use of AI to find new uses of existing drugs
   c) Use of AI to predict drug Absorption, Distribution, Metabolism, and Excretion properties.
   d) Use of AI In developing personalized medicine
   e) Use of AI to improve the accuracy of molecular docking by predicting binding affinities
   f) AI powered smart inhalers

   Note:
   1. Briefly introduce banned/obsolete drugs, focusing on withdrawal reasons and key examples.
   2. Emphasize class-wide drug actions and highlight only major individual drug differences.
   3. Include newly approved clinically relevant drugs while excluding therapeutically insignificant ones.

4. Select prototype drugs from latest authoritative textbooks representing class characteristics.
5. Avoid repetitive teaching - provide overviews for previously covered drug classes.
6. There should be emphasis on therapeutics and while consulting clinical practice guidelines, emphasis should be on pharmacological and/or therapeutic treatment guidelines. Latest and updated guidelines should be discussed. Appropriate references and links are given in list of references along with teaching tips at end of each relevant reference.

Recommended Reading

1. Bertram G. Katzung, Susan Masters, Anthony Trevor. Basic and Clinical Pharmacology, 13th Edition, 2014. A Lange Medical Book. London.
2. Curtis D. Klaassen. Casarett & Doull's Toxicology: The basic science of poisons. 8th Edition, 2013, McGraw Hill Medical Publishing Division, London.
3. Emest Hodgson, Patricia E. Levi. A text book of modern toxicology. 4th edition.2010.John wiley & Sons. Inc.
4. Fank C. Lu and Sam Kacew.Lu's basic toxicology: Fundamentals, target organs and risk assessment, 6th Edition 2012, CRC Press
5. Timbrell J.A. Introduction to Toxicology. 3rd edition, 2001, Taylor & Francis Ltd.

PHL-508 | Cr. Hrs. 1

Pharmacology & Therapeutics (Lab) -IV

Course Learning Outcomes

By the end of this course, students will be able to:

1. Evaluate anesthetic effects of ketamine/xylazine mixture via intraperitoneal administration in rats
2. Assess hypnotic activity of phenobarbital in mice using sleep latency tests
3. Determine hypnotic effects of diazepam in mice through sleep latency tests.
4. Measure antidepressant activity of imipramine using tail suspension test in mice
5. Analyze antidepressant effects of escitalopram using tail suspension test in mice
6. Investigate anticonvulsant properties of diazepam against strychnine-induced seizures in mice
7. Examine anticonvulsant effects of phenobarbital using strychnine seizure model in mice
8. Test anticonvulsant efficacy of diazepam against picrotoxin-induced seizures in mice
   Use of Artificial intelligence tools to determine drug-target interaction
9. AI tool: STITCH
   http://stitch.embl.de/
   a. Open the STITCH website, which is a database for searching drug-target interactions.
   b. Search for a specific drug of interest (e.g., aspirin, paracetamol etc.).
   c. Choose the Homo sapiens as organism
   d. Review the list of potential biological targets (proteins, enzymes, receptors) associated with the drug.
   e. Discuss how these interactions could be linked to the drug's therapeutic effects and side effects.
   f. Perform the procedure using at least 5 different drugs
10. AI tool: PharmGKB
    https://www.pharmgkb.org/
    a. Access the PharmGKB website and search for a drug known to have genetic variation-based dosing guidelines (e.g., Warfarin, Clopidogrel, Tamoxifen, Cisplatin, Abacavir etc.).
    b. Explore the drug's pharmacogenomic information, focusing on how genetic factors influence drug metabolism and response.
    c. Discuss how genetic polymorphisms can predict a patient's response to the drug (e.g., fast vs. slow metabolizers).
    d. Analyze how genetic data can be used to tailor drug therapy for individuals (personalized medicine).
11. Follow OECD Test Guideline 420 for acute oral toxicity studies
12. Follow OECD Test Guideline 452 for chronic toxicity testing
13. Follow OECD Test Guideline 414 for prenatal developmental toxicity studies

Contents

1. Study of Anesthetic Effects of Ketamine/Xylazine Mixture via Intraperitoneal Administration in Rats
2. Study of Hypnotic Activity of Phenobarbital in Mice Using Sleep Latency Tests
3. Study of Hypnotic Effects of Diazepam in Mice Using Sleep Latency Tests
4. Study of Antidepressant Activity of Imipramine in Mice Using Tail Suspension Test
5. Study of Antidepressant Effects of Escitalopram in Mice Using Tail Suspension Test
6. Study of Anticonvulsant Properties of Diazepam Against Strychnine-Induced Seizures in Mice
7. Study of Anticonvulsant Effects of Phenobarbital Using Strychnine Seizure Model in Mice
8. Study of Anticonvulsant Efficacy of Diazepam Against Picrotoxin-Induced Seizures in Mice
9. Study of Drug-Target Interactions Using AI Tool STITCH
10. Study of Pharmacogenomic Drug Analysis Using AI Tool PharmGKB
11. Study of Acute Oral Toxicity Following OECD Test Guideline 420
12. Study of Chronic Toxicity Following OECD Test Guideline 452
13. Study of Prenatal Developmental Toxicity Following OECD Test Guideline 414

Note: A minimum of 10 practicals will be conducted

Recommended Reading

1. American Psychiatric Association. (2010). Practice guideline for the treatment of patients with major depressive disorder (3rd ed.). American Psychiatric Association. https://psychiatryonline.org/pb/assets/raw/sitewide/practice_guidelines/guidelines/mdd.pdf
   Teaching tip: Discuss Figure 1 and 2, table 6, 7, 8, and 11 with students
2. Brunton, L. L., & Knollmann, B. C. (2023). Goodman & Gilman's: The pharmacological basis of therapeutics (14th ed.). McGraw-Hill Education.
3. Cantley, L., Hunter, T., Sever, R., & Thorner, J. (2013). Signal transduction: Principles, pathways, and processes (1st ed.). Cold Spring Harbor Laboratory Press.
4. Cecchin, E., & Stocco, G. (2021). Pharmacogenomics and personalized medicine. MDPI AG.
5. Cullis, P. (2015). The personalized medicine revolution: How diagnosing and treating disease are about to change forever. Greystone Books.
6. Dawkins, R. (2006). The selfish gene (30th anniversary ed.). OUP Oxford.
7. Doudna, J. A., & Sternberg, S. H. (2017). A crack in creation: Gene editing and the unthinkable power to control evolution. HarperCollins.
8. Feng, X., & Xie, H. G. (2016). Applying pharmacogenomics in therapeutics. CRC Press.
9. Ferreira, J. J., Katzenschlager, R., Bloem, B. R., et al. (2013). Summary of the recommendations of the EFNS/MDS-ES review on therapeutic management of Parkinson's disease. European Journal of Neurology, 20(1), 5–15. https://doi.org/10.1111/j.1468-1331.2012.03866.x
   Teaching tip: Discuss table 2 to table 5 with students
10. FitzGerald, J. D., Dalbeth, N., Mikuls, T., et al. (2020). 2020 American College of Rheumatology Guideline for the Management of Gout. Arthritis Care & Research, 72(6), 744–760. https://doi.org/10.1002/acr.24180
    Teaching tip: Discuss table 1 to table 8 with students
11. Fraenkel, L., Bathon, J. M., England, B. R. (2021). 2021 American College of Rheumatology Guideline for the Treatment of Rheumatoid Arthritis. Arthritis Care & Research, 73(7), 924–939. https://doi.org/10.1002/acr.24596
    Teaching tip: Discuss table 1 to 6 with students
12. Ganie, S. A., Ali, A., Rehman, M. U., & Arafah, A. (2023). Pharmacogenomics: From discovery to clinical implementation. Academic Press.
13. Goodwin, G. M., Haddad, P. M., Ferrier, I. N., et al. (2016). Evidence-based guidelines for treating bipolar disorder: Revised third edition recommendations from the British Association for Psychopharmacology. Journal of Psychopharmacology, 30(6), 495–553. https://doi.org/10.1177/0269881116636545
    Teaching tip: Discuss table 4, 5, 6, and 7 with students
14. Hasanzad, M. (2022). Precision medicine in clinical practice. Springer Nature Singapore.
15. Katzung, B. G., & Vanderah, T. W. (2024). Basic & clinical pharmacology (16th ed.). McGraw Hill.
16. Kreutz, R., Brunström, M., Burnier, M., et al. (2024). European Society of Hypertension clinical practice guidelines for the management of arterial hypertension. European Journal of Internal Medicine, 126, 1–15. https://doi.org/10.1016/j.ejim.2024.05.033
    Teaching tip: Discuss Figure 5 to Figure 8 with students.
17. Lodish, H. F., Berk, A. J., & Kaiser, C. A. (2016). Molecular cell biology (8th ed.). W. H. Freeman and Company.

18. Meierkord, H., Boon, P., Engelsen, B., et al. (2010). EFNS guideline on the management of status epilepticus in adults. European Journal of Neurology, 17(3), 348–355. https://doi.org/10.1111/j.1468-1331.2009.02917.x
19. Primorac, D., Höppner, W., & Bach-Rojecky, L. (2024). Pharmacogenomics in clinical practice. Springer International Publishing.
20. Raymon, L. P. (2017). USMLE Step 1: Pharmacology (Version 4.0). Becker Professional Education.
21. Ritter, J. M., Flower, R. J., Henderson, G., Loke, Y. K., MacEwan, D., Robinson, E., & Fullerton, J. (2023). Rang & Dale's pharmacology (10th ed.). Elsevier.
22. Ritter, J., Lewis, L., Mant, T., & Ferro, A. (2008). A textbook of clinical pharmacology and therapeutics (5th ed.). CRC Press. https://doi.org/10.1201/b13234
23. Samson, S. L., et al. (2023). American Association of Clinical Endocrinology Consensus Statement: Comprehensive Type 2 Diabetes Management Algorithm – 2023 Update. Endocrine Practice, 29(5), 305–340. https://doi.org/10.1016/j.eprac.2023.02.001
Teaching tip: Discuss algorithm Figure 1 to algorithm figure 7 with students
24. Sanoudou, D. (2012). Clinical applications of pharmacogenetics. IntechOpen.
25. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. Wiley.
26. Tripathi, K. D. (2018). Essentials of medical pharmacology (8th ed.). Jaypee Brothers Medical Publishers.
27. U.S. Food and Drug Administration. (n.d.). Table of pharmacogenetic associations. https://www.fda.gov/medical-devices/precision-medicine/table-pharmacogenetic-associations
28. Unger, T., Borghi, C., Charchar, F., et al. (2020). 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension, 75(6), 1334–1357. https://doi.org/10.1161/HYPERTENSIONAHA.120.15026
Teaching tip: Discuss figure 1 to figure 4 with students
29. Virani, S. S., Newby, L. K., Arnold, S. V., et al. (2023). 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA guideline for the management of patients with chronic coronary disease: A report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. Circulation, 148(9), e9–e119. https://doi.org/10.1161/CIR.0000000000001168
Teaching tip: Discuss tables of section 4.3.1 till section 4.3.7 with students
30. Wardle, E. N. (2010). Guide to signal pathways in immune cells (1st ed.). Humana. https://doi.org/10.1007/978-1-60327-538-5
31. Wecker, L., & Ingram, S. L. (2024). Brody's human pharmacology: Mechanism-based therapeutics (7th ed.). Elsevier.
32. Whalen, K. (2019). Lippincott® illustrated reviews: Pharmacology (7th ed., C. Feild & R. Radhakrishnan, Eds.). Lippincott Williams & Wilkins.

PHL-716 | Cr. Hrs. 2

Bioethics

Course Learning Outcomes

By the end of the course, students will be able to:

1. Identify and apply fundamental bioethical principles (autonomy, beneficence, non-maleficence, justice) and ethical theories to pharmacology and pharmacy contexts across bench-to-bedside and industrial settings.
2. Design and critique ethically sound human-subject research plans—covering informed consent, risk–benefit analysis, protection of vulnerable populations, and data privacy—aligned with international guidance (e.g., Declaration of Helsinki, CIOMS, ICH-GCP).
3. Evaluate pre-clinical and animal research using GLP and the 3Rs (replacement, reduction, refinement); propose ethically preferable alternatives or refinements and address data integrity in pre-clinical testing.
4. Analyze dilemmas in pharmacy practice and therapeutics—confidentiality, end-of-life care, opioid stewardship, medication errors—and recommend patient-centred, evidence-based actions, including pharmacovigilance and recall decisions.
5. Discuss global and emerging challenges—pandemics, pharmacogenomics, AI/ML, gene editing, health disparities, environmental sustainability—and propose responsible strategies for clinical and industrial applications.

6. Develop and communicate reasoned ethical decisions through case studies and debates, and critically assess professional codes, authorship/publication standards, and data-integrity practices in real-world scenarios.

Contents

1. Foundations of Bioethics in Pharmacology and Pharmacy
- Introduction to Bioethics in Pharmacology and Pharmacy: History, key principles (Beau champ & Childress), major ethical theories.
- Role of ethics across discovery, development, clinical use, and post-market phases.
- Distinctions between clinical (patient-focused) and industrial/lab (process-focused) applications.

2. Ethical Oversight and Review Mechanisms
- Ethics Committees and Review Bodies: Institutional Review Board (IRB)/Independent Ethics Committee (IEC)—composition, SOPs, expedited vs full review, continuing review.
- Introduction to Animal Ethics Committees/IACUC.
- Ethics in the Use of Animals in Pre-Clinical Research: GLP, 3Rs, humane endpoints, anaesthesia/analgesia, species selection and justification, ARRIVE reporting, validated alternatives (in-silico, in-vitro, organoids).

3. Professional and Research Ethics
- Professional Ethics and Codes of Conduct: Pharmacy oaths and codes (FIP, national bodies).
- Conflicts of interest, whistleblowing, authorship, and disclosure expectations.
- Research Ethics in Drug Development: ICH-GCP, trial registration, historical lessons, investigator–sponsor responsibilities, data sharing, and privacy.

4. Patient Rights, Consent, and Equity
- Informed Consent and Patient Autonomy: Consent in trials, dispensing, counselling; readability, cultural considerations, e-consent, special populations.
- Access, Equity, and Justice: Drug pricing, patents/TRIPS, essential medicines, compas sionate use, equitable distribution.

5. Ethical Challenges in Practice and Industry
- Conflicts in the Pharmaceutical Industry: Industry funding, transparency, biased trials, ghostwriting, off-label promotion, risk communication.
- Environmental and Sustainability Ethics: Manufacturing impact, ethical sourcing, green chemistry, waste management, sustainability reporting.
- End-of-Life Care and Palliative Pharmacy: Pain management ethics, palliative sedation, conscientious objection, opioid stewardship, supply-chain responsibility.

6. Ethics in Emerging and Global Contexts
- Pharmacogenomics and Personalized Medicine: Genetic testing, privacy, equitable access, DTC testing, clinical integration.
- Emerging Technologies: AI/ML in drug discovery and clinical support, gene editing (CRISPR), governance and oversight.
- Global Bioethics and Cultural Perspectives: International trials, benefit-sharing, community engagement, industrial globalization

7. Ethical Decision-Making and Contemporary Issues
- Ethical Decision-Making Models: Principlism, deontology, utilitarianism, virtue/care ethics, moral case deliberation, role-playing.
- Bridging Clinical and Industrial Ethics: Supply-chain disruptions, recalls, pharmacovigilance, stakeholder responsibilities.
- Public Health Ethics and Pandemics: Resource allocation, vaccine ethics, emergency authorizations.
- Emerging Trends in Bioethics: Digital health, social media, real-world evidence, open science, regulatory reforms.

Recommended Reading

1. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics* (8th ed.). Oxford University Press.
2. Veatch, R. M., Haddad, A. M., & English, D. C. (2020). *Case Studies in Pharmacy Ethics (*3rd ed.). Oxford University Press.
3. Supplementary readings from journals such as *American Journal of Bioethics, Journal of Medical Ethics, and Hastings Center Report*.
4. Online resources: WHO ethics guidelines; International Pharmaceutical Federation (FIP) Code of Ethics; CIOMS guidelines; World Medical Association's Declaration of Helsinki; ICH-GCP resources.

Courses Schedule
Pharm. D. (Deficiency) Program

1st Semester			2nd Semester		
Course NO.	**Title of Course**	**Cr. Hrs.**	**Course NO.**	**Title of Course**	**Cr. Hrs.**
PHL-711(D)	Clinical Pharmacology	3	PHL -712(D)	Toxicology	3
PHL -715(D)	Anatomy	2	PHL -718(D)	Physiology and Histology (Practical) Pharmaceutical Biochemistry(Practical)	3
PHL -721(D)	Pathology (Theory and Practical)	2 + 1			
Total **5 courses**, making **14 Credit hours** in one year					

Pharm. D. Deficiency Program Courses – Outline
First Semester

PHL-711(D) | Cr. Hrs. 3

Clinical Pharmacology

1. **Introduction to Clinical Pharmacology**
   Terminology, basic components and scope.

2. **Role of Drug Monitoring in Therapeutics**
   Patient profile, diseases profile, drug profile, monitoring responses, monitoring plasma concentration.

3. **Factors Affecting Drug Response**
   Pharmacogentics, drug interactions.

4. **Development of New Drugs**
   Process of drug development, preclinical studies, types of clinical trials, choice of patients, exclusion criteria of patients.

5. **Drugs in Pregnancy**
   Prescribing in pregnancy, harmful effects on fetus. Pharmacokinetics in pregnancy.

6. **Drugs in Infants and Children**
   Practical aspects of prescribing. Pharmacokinetics.

7. **Drugs in Elderly**
   Pharmacokinetics changes. Pharmacodynamic changes

8. **Drug Toxicity**
   Adverse drug reactions. Monitoring adverse drug reactions, benefit risk ratio.

9. **Pharmacology of Nutrients**

Recommended Reading

1. Atkinson, A. J. Jr., Huang, S.-M., Lertora, J. J. L., & Markey, S. P. (2012). *Principles of clinical pharmacology* (3rd ed.). Academic Press.
2. Kimble, M. A. K. (2012). *Koda-Kimble & Young's applied therapeutics: The clinical use of drugs* (10th ed.). Lippincott Williams & Wilkins.
3. McKay, G. A., & Walters, M. R. (2013). *Clinical pharmacology and therapeutics (*9th ed.). Wiley Blackwell.
4. Rataboli, P. V. (2010). *Clinical pharmacology and rational therapeutics* (2nd ed.). Ane Books Pvt. Ltd.
5. Walker, R., & Whittlesea, C. (2011). *Clinical pharmacy and therapeutics* (5th ed.). Churchill Livingstone.

PHL-715(D) | Cr. Hrs. 2

Anatomy

1. **Introduction**
   Anatomical terminology, definition of cell, tissue, organ, structure of cell membrane, cytoplasm organelles, nucleus, cell cycle.

2. **Tissues of Body**
   Cartilage, bone structure and types of bones and joints.

3. **Muscle**
   Structure of skeletal, smooth muscles, and cardiac muscles.

4. **Integumentary System**
   Including skin, glands, hair and nail.

5. **Cardio Vascular System**
   Structure of heart, location, blood supply to heart, types of blood vessels.

6. **Elementary System**
   Name and structure of different parts of elementary system and their inter relationship.

7. **Urinary System**
   Name and structure of organs of urinary system and their inter relationship.

8. **Male and Female Reproductive Systems**
   Endocrine system including pituitary, thyroid and adrenal glands with their structures.

9. **Nervous System**
   Including neuron, organization of CNS, brain, cerebrum, cerebellum, brain stem, pons and medulla oblongata, thalamus, hypothalamus, cranial nerves. Internal structure of spinal cord CSF, sensory and motor pathways, spinal reflexes, peripheral spinal nerves.

10. **Autonomic Nervous System**
    Sympathetic and parasympathetic nervous system.

Recommended Reading

1. Applegate, E. (2010). *The anatomy and physiology learning system* (4th ed.). Saunders.
2. Drake, R. L., Vogl, A. W., & Mitchell, A. W. M. (2014). *Gray's anatomy for students* (3rd ed.). Churchill Livingstone.
3. Martini, F. H. (2014). *Fundamentals of anatomy and physiology* (10th ed.). Prentice Hall.
4. Patton, K. T., & Thibodeau, G. A. (2013). *Anatomy & physiology* (8th ed.). Mosby.
5. Tortora, G. J., & Derrickson, B. (2013). *Principles of anatomy and physiology* (14th ed.). John Wiley & Sons.

PHL-721(D) | Cr. Hrs. 2+1

Pathology (Theory + Practical)

1. **Scope of Pathology and Concept of Diseases**

2. **Definition and Terminology**

Ischemia	.....	Hypoxia
Necrosis	.....	Infarction
Atrophy	.....	Hypertrophy
Hyperplasia	.....	Metaplasia
Aplasia	.....	Anaplasia

3. **Response of Body to Injury and Infection**
   Acute inflammation, chronic inflammation, immunity, allergy and hypersensitivity.

4. **Specific Diseases**
   Peptic and duodenal ulcer, hypertension, leukaemia or blood cancer, malignant carcinoma, sarcoma and lymphomas.

5. **Diagnosis and Treatment of Cancer**
   Fate, survival and prognosis of tumors.

Pathology (Practical)

1. **Study of Pathological Slides of Various Pathological Conditions**
   Acute inflammation, chronic inflammation, chronic specific inflammation, different types of degeneration, thrombosis, embolism, infarction, necrosis, gangrene, hyperplasia, metaplasia, pigmentation, calcification, C.V.C., papilloma, adenoma, chondroma, fibroma, leiomyoma, neofibroma, Squamous cell carcinoma, basal cell carcinoma, transitional cell carcinoma, adenocarcinoma, fibrocarcinoma, rhabdomyosarcoma, leiomyosarcoma, lymphosarcoma, liposarcoma, reticular cell sarcoma, Hodgkin's disease, breast carcinoma, osteogenic, sarcoma, osteoclastoma.

2. **Examination of Different Body Fluids in Various Pathological Conditions**
   Urine complete examination, stool examination, blood complete examination, semen examination, cerebrospinal fluid examination, pericardial fluid examination, pleural fluid examination, aseptic fluid examination, blood sugar, blood urea, blood cholesterol etc.

3. **Tests for Various Specimens of Clinical Importance**
   Techniques of clinical blood examination for various diseases, gastric analysis, tests for liver function test, renal function test, test for endocrine abnormalities, biopsies and cytological techniques.

Recommended Reading

1. Cotran, R. S., Kumar, V., & Robbins, S. L. (2014). Robbins & Cotran pathologic basis of disease (9th ed.). W. B. Saunders Company.
2. Golan, D. E., Tashjian, A. H., Armstrong, E. J., & Armstrong, A. W. (2011). *Principles of pharmacology: The pathophysiologic basis of drug therapy* (3rd ed.).
3. Greene, R. J., & Harris, N. D. (2008). *Pathology and therapeutics for pharmacists: A basis for clinical pharmacy practice* (3rd ed.). Chapman & Hall.
4. Lewis, M. G., & Barton, T. K. (2002). *Appleton & Lange's review of general pathology* (4th ed.). Prentice Hall International Inc.
5. McPhee, S. J., Papadakis, M. A., & Tierney, L. M. (2015). *Current medical diagnosis and treatment* (54th ed.). Lange Medical Books, McGraw-Hill Medical Publishing Division.

Pharm. D. Deficiency Program Courses – Outline
Second Semester

PHL-712(D) | Cr. Hrs. 3

Toxicology

1. **Principles of Toxicology**
   Principles of treatment of poisoning, classification of toxic agents, spectrum of undesired effects, mechanisms of toxicity, risk assessment.

2. **Disposition of Toxicants**
   Absorption, distribution and elimination of toxicants, biotransformation of xenobiotics, toxicokinetics

3. **Target Organs of Toxicity**
   Toxic responses of the blood, toxic responses of the liver, toxic responses of the heart, toxic responses of the kidney, toxic responses of reproductive system.

4. **Environmental Toxicology**
   Air pollution, ecotoxicology, toxic effects of plants.

5. **Application of Toxicology**
   Food toxicology, forensic toxicology, clinical toxicology, occupational toxicology.

Recommended Reading

1. Hodgson, E., & Levi, P. E. (2010). *A textbook of modern toxicology* (4th ed.). John Wiley & Sons, Inc.
2. Katzung, B. G., Masters, S., & Trevor, A. (2014). *Basic and clinical pharmacology* (13th ed.). A Lange Medical Book.
3. Klaassen, C. D. (2013). *Casarett & Doull's toxicology: The basic science of poisons* (8th ed.). McGraw-Hill Medical Publishing Division.
4. Lu, F. C., & Kacew, S. (2012). *Lu's basic toxicology: Fundamentals, target organs, and risk assessment* (6th ed.). CRC Press.
5. Timbrell, J. A. (2001). *Introduction to toxicology* (3rd ed.). Taylor & Francis Ltd.

PHL-718(D) | Cr. Hrs. 2+1

Physiology, Histology and Bio-Chemistry (Practical)

1. **Introduction Experimental Physiology**

2. **Blood**
   Determination of haemoglobin, determination of ESR, RBC count, WBC count, differential leucocyte count, bleeding and clotting time, blood groups.

3. **Respiration**
   Estimation of vital capacity and its relation to posture and standard vital capacity, determination of tidal volume, demonstration of artificial respiration.

4. **C.V.S**
   Recording of arterial pulse, recording of arterial B.P.

5. **Eye**
   Visual acuity, far vision, near vision and field of vision.

6. **C.N.S**
   Nerve muscle preparation in frog, effect of temperature on muscle, demonstration of special reflexes.

7. **Histology**
   Demonstration, preparation and staining of the slides, histological examination of slides, epithelium, connective tissue, muscle tissue, organ –system –lungs, kidney, appendix, skin, gall–bladder, stomach, intestine.

8. **Qualitative Analysis**
   Carbohydrates. amino acids, peptides and proteins. Lipids and sterols (cholesterol) bile salts and bilirubin. Blood analysis-sugar, uric acid, bilirubin, cholesterol and creatinine.

9. **Quantitative Analysis**
   Carbohydrates-glucose (reducing sugar) and any other carbohydrate using Benedict and Anthrone method. Amino acids, peptides and proteins using Biuret and Ninhydrin (Spectrophotometric) method. Analysis of normal and abnormal components of urine –sugar, uric acid, bilirubin, cholesterol and creatinine.

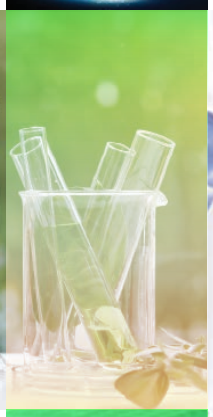
Recommended Reading

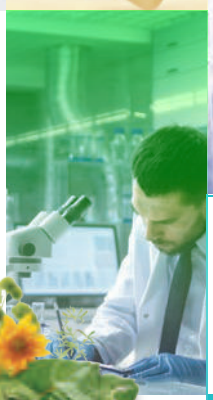
1. Champe, P. C., & Harvey, R. A. (2013). *Lippincott's illustrated review: Biochemistry (*6th ed.). Lippincott Williams & Wilkins.
2. Guyton, A. C., & Hall, J. E. (2015). *Textbook of medical physiology* (13th ed.). W.B. Saunders.
3. Murray, R. K. (2015). *Harper's illustrated biochemistry* (30th ed.). Lange Medical Books, McGraw-Hill.
4. Paulsen, D. F. (2010). *Basic histology: Examination and board review* (5th ed.). Prentice Hall International, Inc.
5. Tortora, G. J., & Grabowski, S. R. (2013). *Principles of anatomy and physiology* (14th ed.). John Wiley & Sons.

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Department of
Pharmacognosy







Message

The Chairman, Department of Pharmacognosy

The discipline of Pharmacognosy is the formal study of natural products from all aspects. It is an important and integral part of modern medical research, and its horizons will keep on expanding as we explore nature for its hidden secrets.

Surprisingly, even with our great strides in medicine and our relative drug sophistication, the recent years have witnessed a renewed interest in natural products. In current scenario, this applied branch of pharmaceutical sciences also covers the emerging disciplines such as Phytochemistry, Medicinal Chemistry, Plant toxicology, Histology, Chemotaxonomy, Phytomedicine, Oceanography, Pharmacokinetics and dynamics, and Pharmacoeconomics to provide relief to human sufferings.

I pray to Almighty ALLAH for all students that the spark of faith and knowledge kindled in your hearts may enlighten further lights and let not the knowledge gained by you be restricted only to your own benefits but it may be transmitted to succeeding generations as well. I also pray that you attain not only remarkable success in this world but succeed in the life hereafter as well since it is the main aim of education.

Praying for your bright future.

Prof. Dr. Muhammad Mohtasheem ul Hasan

Chairman

Department of Pharmacognosy

Pharmacognosy derives its origin from two Greek words, pharmakon meaning drug, and gnosis meaning knowledge. It is the study of natural bioactive substances obtained from terrestrial and marine plants, animals, microbes and minerals for their physical, chemical, biochemical and biological properties, their taxonomy and ethnobiology. Pharmacognosy is one of the major areas of pharmaceutical sciences; today is a highly interdisciplinary science, linked to phytochemistry, microbial chemistry, biosynthesis, biotransformation, chemotaxonomy, biotechnology and other biological and chemical sciences. Research in Pharmacognosy provides for the discovery of lead compounds for drug development, new methods of analysis for drugs, toxins and herbal preparations.

The objective of the Department of Pharmacognosy is to educate students about the natural source of drugs, their pharmacognostic and phytopharmacological attributes, chemical and spectroscopic profile of isolated molecules and their development as modern pharmaceutical products.

"Then eat from all the fruits and follow the ways of your Lord laid down [for you]. There emerges from their bellies a drink (honey), varying in colors, in which there is healing for people. Indeed in that is a sign for a people who give thought." (Sūrat l-Nahl: verse 68-69)

The Prophet Muhammad (PBUH) said, "Make use of the two cures: honey and the Qur'an". (Ibn Majah & others)

Hazrat Abu Hurairah States – "I have heard from Rasool Allah (PBUH) that there is cure for every disease in black seeds except death and black seeds are Shooneez."

Hippocrates, the father of modern medicine, 2,500 years ago said, "Let food be thy medicine and medicine be thy food".

Contact Details:
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website: **https://www.uok.edu.pk/faculties/pharmacognosy/index.php**

Department of **Pharmacognosy**

Vision

"Advancing the science of Pharmacognosy and its application by integrating traditional knowledge, natural products, and modern techniques to develop safe, effective, and innovative solutions in medicine and healthcare."

Mission

“To advance the science of Pharmacognosy by integrating traditional medicinal knowledge, modern medicine and natural products with cutting-edge research and modern techniques, thereby developing safe, effective, and innovative solutions for medicine and healthcare.”

Dr. Muhammad Mohtasheem ul Hasan

Chairman and Professor

Qualification
Ph.D., M.Phil., B.Pharm.
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Muhammad Mohtasheem ul Hasan graduated from Faculty of Pharmacy, University of Karachi and got M.Phil. and Ph.D. degrees in Pharmacognosy from the same institution. He has worked in quality control department in W. Woodward, Searle and B. Braun Pakistan. He has also worked in Hamdard University as Research Associate. He has authored 134 research papers in National and International reputed journals. He has supervised 25 M.Phil. and 3 Ph.D. students.

Dr. Huma Sharif

Professor

She has enormous professional teaching and research experience including undergraduates and postgraduate students at different private and public sector universities with sound knowledge of instructional and web technologies. Earlier, she worked in multinational and national pharmaceutical industry.
Prof. Shareef's research interest lies in phytomedicine development and phytochemical analysis of medicinal plants, modern extraction procedures, nanotechnology based targeted drug delivery of herbal drugs. She also investigated the pharmacological importance of medicinal plants in different in vivo and in vitro animal models. Nutraceuticals and cosmeceuticals are also here interests.

Qualification
Post Doc (UCL, London), Ph. D, M.Phil., Pharm. D (condensed), B.Pharm. PGD(Stat.) (University of Karachi); DHEP (LUMS)

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Dr. Maryam Ahmed

Associate Professor

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Maryam Ahmed received B.Pharm. and Ph.D. degrees from department of Pharmacognosy, Faculty of Pharmacy and Pharmaceutical sciences, University of Karachi. In 2014 awarded for gold medal from Pakistan Society of Pharmacognosy.
Her research and teaching focus on the phytochemicals, nutraceuticals, cosmeceuticals and herbal contributions in the clinical management of diseases.

Ms. Farah Mazhar

Assistant Professor

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2000

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Ms. Farah Mazhar is an academic and researcher in Pharmacognosy, with over two decades of teaching and research experience at the University of Karachi, Pakistan. She earned her M.Phil. and B.Pharm. degrees, from the University of Karachi, Pakistan.

Her research is focused on phytochemistry, pharmacognostic and biological evaluation of natural products, and phytocosmeceutical. Her expertise spans phytopharmaceuticals, phytochemistry, the biological and chemical analysis of natural products, and standardization of herbal medicines.

Ms. Mazhar has authored number of research papers, book, and book chapters, contributing significantly to Pharmacognosy and Pharmaceutical sciences. She has been recognized with the Gold Medal by the Pakistan Society of Pharmacognosy and as a Productive Scientist of Pakistan by the Pakistan Council for Science and Technology.

An active member of professional societies, she has organized and participated in various national and international workshops, seminars, and conferences. She is also a registered pharmacist and an advocate for advancing research and quality education in Pharmacognosy.

Dr. Salman Ahmed

Assistant Professor

Qualification
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2013

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Salman Ahmed holds a B.Pharm., degree from the University of Karachi, Pakistan, and a Ph.D., and M.Phil., in Pharmacognosy from the same institution. He has gained valuable experience in the pharmaceutical industry, having worked at Helix Pharma, Pharm Evo (Pvt.) Ltd., and Searle Pakistan Ltd. He has been an Assistant Professor in the Department of Pharmacognosy at the Faculty of Pharmacy, University of Karachi, Pakistan since 2016. He has authored 114 research papers (91 International and 23 National). Additionally, he has written 7 books and presented 16 posters at national and international conferences. Salman Ahmed's expertise is acknowledged by various esteemed journals published by Elsevier, Springer Nature, Wiley, MDPI, Hindawi, and Dove Medical Press Limited, as he serves as an invited reviewer for these publishers.

Dr. Safia Abidi

Assistant Professor

Qualification
Ph.D., M.Pharm., B.Pharm.
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2012

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Safia Abidi, B.Pharm., M.Pharm., Ph.D., RPh. is an Assistant Professor in the Department of Pharmacognosy, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi. She received her B.Pharm. from Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 2006. In 2010 she completed her Masters in Pharmacy. She then received her Ph.D. in Pharmacognosy from Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi in 2018. Her research and teaching is based on natural product and ethanopharmacognosy of natural biomarkers, formulation and development of medicines from natural sources, nutraceutical, and cosmeceuticals.

Board of Studies

Dr. Muhammad Mohtasheem ul Hasan
Chairman and Professor

Dr. Huma Sharif
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Department of Pharmaceognosy
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Dr. Maryam Ahmed
Associate Professor
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Ms. Farah Mazhar
Assistant Professor
Department of Pharmaceognosy
University of Karachi

Prof. Dr. Nudrat Fatima
Principal
College of Pharmacy
Ziauddin University
Link Road, Karachi

Prof. Dr. Sheikh Abdul Khaliq
Department of Pharmacy
Hamdard University
Karachi

Dr. Zafar Alam Mehmood
Country Manager,
Colorcon Limited England
A Subsidiary of Brewing Pharmaceutical Inc.
Dartford, Kent, UK.

Dr. Faheem Ahmed
Plant Manager
Bosch Pharmaceuticals (Pvt.) Ltd.
Karachi

Pharm. D. Courses

First Semester

Course NO.	Course Title	Cr. Hrs.	Category
First Professional			
PHG-317	Functional English	3	General Edu.
Second Professional			
PHG-409	Pharmacognosy (Basic - I)	3	Core
PHG-411	Pharmacognosy (Basic - Lab-I)	1	Core
Third Professional			
PHG-509	Pharmacognosy (Applied)	3	Core
PHG-511	Pharmacognosy (Applied) Lab	1	Core
PHG-517	Ideology and Constitution of Pakistan	2	General Edu.

Second Semester

Course NO.	Course Title	Cr. Hrs.	Category
Second Professional			
PHG-414	Pharmacognosy (Basic-II)	3	Core
PHG-416	Pharmacognosy (Basic- Lab-II)	1	Core
PHG-420	Pakistan Studies	2	General Edu.
Third Professional			
PHG-510	Pharmacognosy (Advanced)	3	Core
PHG-512	Pharmacognosy (Advanced) Lab	1	Core
Total 11 **Courses** worth **23 Credit Hours** in five years			

Pharm. D. Courses – Outline

First Semester

PHG-317 | Cr. Hrs. 3

Functional English

Course Learning Outcomes

1. Read and identify main ideas and key details.
2. Write simple, clear texts such as CVs and letters.
3. Speak clearly with correct pronunciation and give short presentations.
4. Understand main points in spoken content and join discussions.
5. Use common vocabulary and basic word-formation.
6. Use basic grammar, tenses, modals, articles, and punctuation correctly.

Contents

Reading and Writing Skills
Upon successful completion of this course, students will be able to:
- Preview or survey news reports and book chapters and capture the theme in one sentence.
- Scan an essay, article or book section and locate specific information efficiently.
- Comprehend short informational and imaginative texts.
- Follow the process model to develop a written response to a situational prompt (e.g. request for a contribution to the school newsletter on a current topic for a defined readership, proposal to the university administration for a green campus etc.).
- Prepare a CV and a job application letter customized for the advertised post.

Oral Interaction Skills
Upon successful completion of this course, students will be able to:
- Articulate English phonemes (consonants and vowels) and identify basic terms related to pronunciation (e.g. phoneme, vowel, consonant, syllable, stress etc.).
- Pronounce common English words using in the standard universal English accent.
- Follow the process method to develop informational and persuasive speeches.
- Organize and deliver academic and professional presentations.
- Demonstrate skillful use of voice variation, gestures, eye communication and other aspects of body language.
- Participate in scenario discussions using a problem-solving decision-making template
- Demonstrate a global (general) understanding of short and long pieces of oral communication (interviews, speeches and documentaries).

Vocabulary Skills
Upon successful completion of this course, students will be able to:
- Compound their vocabulary recognition and use with prefixes, suffixes and roots.
- Use word-formation rules (derivation, conversion, compounding and blending).
- Master the first 10sub-lists comprising essential academic vocabulary from Academic Word List.
- use expressions and phrases in lists from A1 to B2 in the Oxford Phrase List: (https://www.oxfordlearnersdictionaries.com/external/pdf/wordlists/oxford-phrase-list/Oxford%20Phrase%20List.pdf)

Grammar Skills
Upon successful completion of this course, students will be able to:
- Identify and define basic grammatical terms (phrase, clause, sentence etc.)
- Recognize the main types of simple sentences in English (SV, SVO,SVO, SVC, SVA etc.).
- Use commonly used past and present tenses (simple, continuous and perfect) correctly.

- Learn ways to talk about the future.
- Express possibility, ability, permission, obligation and necessity using modal verbs.
- Employ English articles appropriately in common contexts.
- Understand and use common punctuation marks (the fullstop, comma, question mark and inverted commas) as well as capitalization rules correctly in writing.

Recommended Reading

1. Behrens, L., & Rosen, L. J. (2018). Writing and Reading Across the Curriculum (14th edition). Pearson. Bolen, J. (2020). ESL Listening Activities for Teen agers and Adults: Practical Ideas for the Classroom. Independently published.
2. Brezina, C. (2008). Great Decision-Making Skills. The Rosen Publishing Group, Inc. Coleman, K. (2019). Conversation Skills: Useful Methods and Advice to Conquer Small Talk, Improve Social Confidence and Network Like Never Before. Communication & Social Skills.
3. Coxhead, A. (2023, March29). The Academic Word List. Victoria University of Wellington. https://www.wgtn.ac.nz/lals/resources/academicwordlist
4. Eastwood, J. (2006). Oxford Practice Grammar: With Answers. Oxford University Press.
5. Kaufman, L., & Straus, J. (2021). The Blue Book of Grammar and Punctuation: An Easy-to-Use Guide with Clear Rules, Real-World Examples, and Reproducible Quizzes (12th edition). Jossey-Bass.
6. Kaye, E. A. (2002). Maximize Your Presentation Skills: How to Speak, Look and Action Your Way to the Top. Three Rivers Press.
7. Lele, C., & Magoosh. (2018). The Vocabulary Builder Work book: Simple Lessons and Activities to Teach Yourself Over 1,400 Must-Know Words (Workbook edition). Callisto.
8. Lewis, N. (2014). Word Power Made Easy: The Complete Handbook for Building a Superior Vocabulary. Anchor.
9. Lindsell-Roberts, S. (2010). Speaking Your Way to Success. Houghton Mifflin Harcourt. Lucas, S. (2019). The Art of Public Speaking (13th edition). McGraw-Hill Education.
10. Mandel, S. (2000). Effective Presentation Skills: A Practical Guide for Better Speaking. Crisp Publications.
11. Matthews, J. (2020). How to Write a 5-Paragraph Essay Step-by-Step. Independently published. McLendon, L. (2017). The Perfect English Grammar Workbook: Simple Rules and Quizzes to Master Today's English (Workbook edition). Callisto.
12. Neumann, D. J. (2016). A Professor's Guide to Writing Essays: The No-Nonsense Plan for Better Writing. Jacob Neumann.
13. The Beginner's Guide to Writing an Essay: Steps & Examples. (n.d.). Scribbr.RetrievedAugust22, 2024, from https://www.scribbr.com/category/academic-essay/

PHG-409 | Cr. Hrs. 3

Pharmacognosy (Basic - I)

Course Learning Outcomes

After completing this course, students will be able to:

1. Explain pharmacognosy's historical development, scope, and modern concepts, including its role in the national economy and herbal pharmacopoeias.
2. Demonstrate an understanding of traditional and alternative systems of medicine, such as Unani, Ayurveda, Homeopathy, and Traditional Chinese Medicine.
3. Identify, classify, and describe the sources, constituents, and uses of plant, animal, mineral, and microbial origin crude drugs.
4. Evaluate crude drugs using organoleptic and microscopic methods; also recognize types of adulteration in crude drugs.
5. Perform practical skills like section cutting and powder drug microscopy in the lab.

Contents

1. **General Introduction and Scope of Pharmacognosy**
   - i. Historical development, scope and importance of Pharmacognosy
   - ii. Role of medicinal plants in the national economy
   - iii. Flora of Pakistan and indigenous medicinal plant resources
   - iv. Study of herbal pharmacopoeia

v. Modern concepts of Pharmacognosy and the role of pharmacognosist.
vi. Traditional and alternative systems of medicine (Unani, Ayurveda, Homeopathy, Chinese Traditional Medicine)

2. Crude Drugs
i. Introduction and sources of crude drugs
ii. Preparation of crude drugs for commercial market and industry: Cultivation,collection, garbling, drying, storage, preservation, and packaging
iii. Regulatory guidelines for the cultivation and collection of herbal drugs
iv. Classification of crude drugs with special emphasis on chemical and therapeutic system of classification
v. Organoleptic and microscopic evaluation of crude drugs
vi. Definition, types and detection of adulteration

3. Drugs from Plants: Carbohydrates, Fixed oils, Resins, Tannins, Phytoenzymes
i. Carbohydrates: Cellulose, Tragacanth, Acacia, Agar, Xanthan, Algin, Pectin
ii. Fixed oils: Castor oil, Olive oil, Coconut oil, Almond oil, Linseed oil, Mustard oil
iii. Resins: Introduction, classification, active constituents and medicinal uses of Jalap, Asafoetida, Cannabis, Podophyllum
iv. Tannins: Introduction, classification, identification tests. Study of Catechu, Nutgall, Myrobalan
v. Phytoenzymes: Papain, Bromelain and Malt Extract

4. Drugs from Animal, Mineral and Microbial Origin
i. Animal origin drugs: Honey, Gelatin, Musk, Shellac, Cantharide, Cod-liver oil, Rennin, Catgut, Silk, Wool, Pepsin, Pancreatin, Pancrealipase, Chymotrypsin
ii. Mineral origin drugs: Shilajeet, Asbestos, Kaolin
iii. Microbial origin drugs: Penicillin, Streptomycin, Streptokinase, Serratiopeptidase, Sutilains, Asparaginase

Recommended Reading

1. Evans, W.C. (2020). Trease and Evans Pharmacognosy(17thed), Saunders. Perve) Pharmacognosy: Medicinal plants. Intech Open.
2. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson. (2017). Fundamentals of Pharmacognosy and Phytotherapy, Elsevier Health Sciences.
3. Kayne, S. B. (2008). Text book of Complementary and Alternative Medicine (2nded.). Pharmaceutical Press.
4. Hussain, A., & Qarshi, I.A. (2021). Dictionary of Pakistani Medicinal Plants (Vol. I). Qarshi University Lahore.
5. Dastur, J.F. (1970). Medicinal Plants of India and Pakistan. DBTaraporevala Sons & Co Private Ltd.
6. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
7. Tyler, V. E., Brady, L. R., & Robbers, J. E. (1988). Pharmacognosy (9thed.). Philadelphia, PA: Lea & Febiger.
8. Jackson, B.P., & Snowdon, D.W. (1968). Powdered Vegetable Drugs: An atlas of microscopy for use in the identification and authentication of some plant materials employed as medicinal agents. Churchill.
9. Wallis, T. E. (2005). Textbook of Pharmacognosy (5thed.). CBS Publishers & Distributors.

PHG-411 | Cr. Hrs. 1

Pharmacognosy (Basic-Lab-I)

Course Learning Outcomes

By the end of this course, students will be able to:
1. Organoleptic (Macroscopic) Evaluation of Crude Drugs
   i. Identify and differentiate various categories of organized crude drugs using organoleptic and macroscopic characteristics.
   ii. Describe and apply the organoleptic parameters for quality assessment of organized crude drugs.
   iii. Examine and classify unorganized crude drugs based on appearance, consistency, sensory attributes, and physical behavior.

iv. Evaluate the quality and purity of organized and unorganized drugs using standard macroscopic criteria and compare them with official pharmacopoeial standards.

2. Microscopic Evaluation of Crude Drugs
   i. Prepare transverse sections of root, stem, leaf, bark, and fruit crude drugs using standard cutting and staining techniques.
   ii. Recognize and interpret key anatomical features visible in transverse sections.
   iii. Perform powder microscopy of crude drugs and identify diagnostic microscopic.
   iv. Compare microscopic features of crude drug samples with standard monographs to determine authenticity, quality, and possible adulteration.
   v. Apply microscopy and organoleptic methods in an integrated manner to authenticate crude drugs and ensure compliance with pharmacognostic quality standards.

Contents

1. **Organoleptic (Macroscopic) Evaluation of Crude Drugs**
   i. Evaluation of organized crude drugs, i.e., roots, rhizomes, barks, leaves, flowers, fruits and seeds.
   ii. Evaluation of unorganized drugs, i.e., gums, latex, exudates and oils

2. **Microscopic Evaluation of Crude drugs**
   i. Transverse section cutting and staining:
   Introduction and methodology of transverse section cutting and staining for root, fruit, leaf, stem and bark crude drugs.
   ii. Powder microscopy of crude drugs:
   Microscopic evaluation of powdered crude drugs and their comparison with the standard monographs.

(Note: A minimum of 10 practicals will be conducted).

Recommended Reading

1. Evans, W.C. (2020). Trease and Evans Pharmacognosy(17thed), Saunders. Perve) Pharmacognosy: Medicinal plants. Intech Open.
2. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson. (2017). Fundamentals of Pharmacognosy and Phytotherapy, Elsevier Health Sciences.
3. Kayne, S. B. (2008). Text book of Complementary and Alternative Medicine (2nded.). Pharmaceutical Press.
4. Hussain, A., & Qarshi, I.A. (2021). Dictionary of Pakistani Medicinal Plants (Vol. I). Qarshi University Lahore.
5. Dastur, J.F. (1970). Medicinal Plants of India and Pakistan. DBTaraporevala Sons & Co Private Ltd.
6. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
7. Tyler, V. E., Brady, L. R., & Robbers, J. E. (1988). Pharmacognosy (9thed.). Philadelphia, PA: Lea & Febiger.
8. Jackson, B.P., & Snowdon, D.W. (1968). Powdered Vegetable Drugs: An atlas of microscopy for use in the identification and authentication of some plant materials employed as medicinal agents. Churchill.
9. Wallis, T. E. (2005). Textbook of Pharmacognosy (5thed.). CBS Publishers & Distributors.

PHG-509 | Cr. Hrs. 3

Pharmacognosy (Applied)

Course Learning Outcomes

After completing this course, students will be able to:

1. Understand and apply chromatographic techniques, including paper, thin layer, and column chromatography, for the identification and isolation of natural products, with basic knowledge of advanced hyphenated techniques.
2. Learn conventional and modern extraction techniques used for isolating plant-based compounds.
3. Introduce molecular Pharmacognosy techniques such as DNA bar coding, molecular markers, tissue culture, and genetic regulation of plant metabolites.
4. Understand the clinical relevance, efficacy, and safety of selected herbal drugs used in common ailments.

5. Support learning of chromatography and plant authentication by DNA bar coding through practical work.

Contents

1. **Chromatographic Techniques for Identification and Isolation of Natural Products**
   - i. Introduction and types of chromatography, i.e., adsorption and partition chromatography, commonly used stationary and mobile phases in chromatography, Normal phase and reverse phase chromatography
   - ii. Detailed study of chromatographic techniques, including paper chromatography, thin layer chromatography (TLC), and column chromatography
   - iii. A brief introduction of hyphenated chromatographic techniques, i.e., HPLC-DAD, HPTLC-MS, GC-MS, LC-MS, GC-FTIR, LC-FTIR, LC-NMR

2. **Extraction Techniques for Natural Products**
   - i. Conventional extraction techniques
     Definition, process, merits, and demerits of various conventional extraction techniques of natural products, including maceration, percolation, digestion, infusion, decoction, and Soxhlet extraction.
   - ii. Advanced extraction techniques
     Definition, process, merits, and demerits of various advanced extraction techniques of natural products, including ultrasonic-assisted extraction, microwave-assisted extraction, supercritical fluid extraction, and pressurized solvent extraction.

3. **Molecular Pharmacognosy**
   - i. General introduction to molecular pharmacognosy
   - ii. Basic tools used in molecular pharmacognosy
   - iii. Molecular authentication techniques for medicinal plants, including DNA barcoding, molecular markers like RAPD, AFLP, and SSR
   - iv. Molecular methods for the detection of adulteration and substitution in drugs
   - v. Metabolic pathways in plants and their genetic regulations for the production of desired constituents
   - vi. Cell and tissue culture techniques
   - vii. Bioprocessing technologies, including biologics
   - viii. Allergenic extracts
   - ix. Applications of molecular pharmacognosy

4. **Natural Medicine Practice-I**
   - i. General introduction
   - ii. A detailed study of clinical efficacy, mechanism of action, part used, dose, dosage form, and adverse effects of herbal drugs in various ailments, including;
   - iii. Skin diseases: *Aloe barbadensis, Curcuma longa, Angelica archangelica, Mentha piperita, Melaleuca alternifolia, Glycyrrhiza glabra*
   - iv. Musculoskeletal disorders: *Nigella sativa, Phycotis ajowan, Trigonella foenum-graecum, Zingiber officinale*
   - v. Hepatitis: *Berberis vulgaris, Silybum marianum, Melaleuca alternifolia*
   - vi. Diabetes: *Gymnema sylvestre, Momordica charantia, Cinnamomum zeylanicum, Syzygium jambulana, Withania coagulans*
   - vii. G.I.T. disorders: *Foeniculum vulgare, Ferula foetida, Cassia angustifolia*
   - viii. Antimalarial: *Cinchona officinalis, Artemisia annua*

Recommended Reading

1. Braithwaite, A., & Smith, F. J. (2012). Chromatographic Methods (5thed.). Springer.
2. Gong, X. (2023). Separation, Extraction, and Purification of Natural Products from Plants. MDPI.
3. Prado, J., & Rostagno, M. (2022). Natural Product Extraction: Principles and Applications (2nded.). Royal Society of Chemistry.
4. Purkait, M. K., Haldar, D., & Duarah, P. (2022). Advances in Extraction and Applications of Bioactive Phytochemicals. Elsevier.
5. Huang, L. Q. (2019). Molecular Pharmacognosy (2nded.). Springer.

6. Bhatt, M., Joshi, M., & Sharma, S. (2024). Molecular Pharmacognosy–Advances in DNA-based techniques for authentication of botanicals in medicinal food and herbal drugs. In M. Kaneria & K. Rakholiya, Drug discovery update: Herbal formulations, phytochemistry and pharmacognosy (pp. 153–164). Elsevier.
7. Benzie, I. F. F., & Wachtel-Galor,S. (2011). Herbal Medicine: Biomolecular and Clinical Aspects (2nd ed.). CRC Press/Taylor & Francis.
8. Pizzorno, J. E., & Murray, M. T. (2012). Textbook of Natural Medicine(4thed.). Elsevier.
9. McTaggart, L. A. (2018). Herbal Therapeutics: A Clinical Guide. Springer.
10. Braun, L. (2009). Clinical Guide to Herbal Medicine. Elsevier.

PHG-511 | Cr. Hrs. 1

Pharmacognosy (Applied) Lab

Course Learning Outcomes

By the end of this course, students will be able to:

1. Perform chromatographic (paper, TLC, and column chromatography) and molecular (DNA extraction/barcoding) techniques for the separation and authentication of crude drugs.
2. Identify chemical constituents and plant species using chromatographic profiles and DNA-based markers.
3. Interpret and document analytical results to assess the purity, quality, and authenticity of natural products.

Contents

The practicals of the subject shall be designed from time to time based on the above-mentioned theoretical topics and availability of the facilities.

1. Chromatographic separation of various constituents from crude drugs /natural products using paper, TLC, and column chromatography.
2. DNA extraction and/or barcoding for plant authentication. Minimum of 10 practicals will be conducted)

Recommended Reading

1. Braithwaite, A., & Smith, F. J. (2012). Chromatographic Methods (5thed.). Springer.
2. Gong, X. (2023). Separation, Extraction, and Purification of Natural Products from Plants. MDPI.
3. Prado, J., & Rostagno, M. (2022). Natural Product Extraction: Principles and Applications (2nded.). Royal Society of Chemistry.
4. Purkait, M. K., Haldar, D., & Duarah, P. (2022). Advances in Extraction and Applications of Bioactive Phytochemicals. Elsevier.
5. Huang, L. Q. (2019). Molecular Pharmacognosy (2nded.). Springer.
6. Bhatt, M., Joshi, M., & Sharma, S. (2024). Molecular Pharmacognosy–Advances in DNA-based techniques for authentication of botanicals in medicinal food and herbal drugs. In M. Kaneria & K. Rakholiya, Drug discovery update: Herbal formulations, phytochemistry and pharmacognosy (pp. 153–164). Elsevier.
7. Benzie, I. F. F., & Wachtel-Galor,S. (2011). Herbal Medicine: Biomolecular and Clinical Aspects (2nd ed.). CRC Press/Taylor & Francis.
8. Pizzorno, J. E., & Murray, M. T. (2012). Textbook of Natural Medicine(4thed.). Elsevier.
9. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
10. McTaggart, L. A. (2018). Herbal Therapeutics: A Clinical Guide. Springer.
11. Braun, L. (2009). Clinical Guide to Herbal Medicine. Elsevier.

PHG-517 | Cr. Hrs. 2

Ideology and Constitution of Pakistan

Course Learning Outcomes

By the end of this course, student will be able to:

1. Demonstrate enhanced knowledge of the basis of the ideology of Pakistan with special reference to the contributions of the founding fathers of Pakistan.
2. Demonstrate fundamental knowledge about the Constitution of Pakistan 1973 and its evolution.
3. Explain about the guiding principle on rights and responsibilities of Pakistani citizens as enshrined in the Constitution of Pakistan 1973.

Contents

1. **Introduction to the Ideology of Pakistan**
   - Definition and significance of ideology
   - Historical context of the creation of Pakistan (with emphasis on socio-political, religious, and cultural dynamics of British India between 1857 till 1947).
   - Contribution of founding fathers of Pakistan in the freedom movement including but not limited to Allama Muhammad Iqbal, Muhammad Ali Jinnah., etc.
   - Contribution of women and students in the freedom movement for separate homeland for Muslims of British India.

2. **Two-Nation Theory**
   - Evolution of the Two-Nation Theory (Urdu-Hindi controversy, Partition of Bengal, Simla Deputation 1906, Allama Iqbal's Presidential Address 1930, Congress Ministries 1937 Lahore Resolution 1940).
   - Role communalism and religious differences.

3. **Introduction to the Constitution of Pakistan**
   - Definition and importance of a constitution.
   - Ideological factors that shaped the Constitution (s) of Pakistan (Objective Resolution 1949).
   - Overview of constitutional development in Paksitan.

4. **Constitution and State Structure**
   - Structure of Government (executive, legislature and Judiciary).
   - Distribution of powers between federal and provincial government.
   - 18th Amendment and its impact on federalism

5. **Fundamental Rights, Principles of Policy and Responsibilities**
   - Overview of fundamental rights guaranteed to citizen by the Constitution of Pakistan 1973 (Articles 8-23).
   - Overview of Principle of Policy (Articles 29-40).
   - Responsibilities of the Pakistani Citizens (Article 5).

6. **Constitutional Amendments**
   - Procedures for amending the Constitution
   - Notable constitutional amendments and their implications

Recommended Reading

1. "The Idea of Pakistan" by Stephen P. Cohen.
2. "Ideology of Pakistan" by Javed Iqbal.
3. "The Struggle for Pakistan" by I. H. Qureshi.
4. "Pakistan the Formative Phase" by Khalid Bin Sayeed
5. "Pakistan: Political Roots and Development" by Safdar Mahmood
6. "Ideology of Pakistan" by Sharif-ul-Mujahid.
7. "The Struggle for Pakistan: A Muslim Homeland and Global Politics" by Ayesha Jalal.
8. "Jinnah, Pakistan and Islamic Identity: The Search for Saladin" by Akbar S. Ahmed.

9. "The Making of Pakistan: A Study in Nationalism" by K.K.Aziz.
10. "Pakistan: A New History" by Ian Talbot.
11. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring
12. "The Constitution of Pakistan 1973". Original
13. "Constitutional and Political Development of Pakistan" by Hamid Khan.
14. "The Parliament of Pakistan" by Mahboob Hussain.
15. "Constitutional Development in Pakistan" by G.W. Choudhury
16. "Constitution-Making in Pakistan: The Dynamics of Political Order" by G.W. Choudhury

Pharm. D. Courses – Outline
Second Semester

PHG-414 | Cr. Hrs. 3
Pharmacognosy (Basic-II)

Course Learning Outcomes

After completing this course, students will be able to:

1. Classify and describe the chemistry, extraction methods, sources, and pharmacological uses of crude drugs containing volatile oils.
2. Learn about classification, chemistry, source, active constituents and medicinal uses of crude drugs belonging to various classes of glycosides and alkaloids.
3. Understand marine natural products, highlighting their bioactive compounds and potential medicinal applications.
4. Reinforce theoretical knowledge through hands-on experience in extracting and identifying active constituents from crude plant materials through practical sessions.

Contents

1. **Volatile Oils (Essential Oils) Containing Drugs**
   Introduction, significance, methods of obtaining volatile oils, chemistry, and classification of volatile oils. Study of crude drugs belonging to various classes of volatile oils, including;

   i. Hydrocarbon volatile oils: Cubeb, Turpentine
   ii. Alcoholic volatile oils: Peppermint, Coriander, Cardamom
   iii. Aldehydic volatile oils: Orange peel, Lemon peel, Lemon grass, Cinnamon
   iv. Ketonic volatile oils: Camphor, Spearmint, Caraway
   v. Phenolic volatile oils: Clove, Thyme
   vi. Phenolic ether volatile oils: Fennel, Anise, Myristica
   vii. Oxide volatile oils: Eucalyptus
   viii. Ester volatile oils: Rosemary, Lavender, Winter Green

2. **Glycosides Containing Drugs**
   Introduction and classification of glycosides. Study of sources, active constituents and medicinal uses of crude drugs belonging to various classes of glycosides, including.

   i. Steroidal glycosides: Digitalis, Strophanthus
   ii. Anthraquinone glycosides: Aloe, Senna
   iii. Saponin glycosides: Glycyrrhiza, Ginseng
   iv. Cyanophore glycosides: WildCherry, Bitter Almond
   v. Isothiocyanate glycosides: Mustard, Moringa
   vi. Aldehyde glycosides: Vanilla

vii. Flavonoid glycoside: Silybum
viii. Alcoholic glycosides: Salix

3. Alkaloids Containing Drugs

Introduction and classification of alkaloids. Study of sources, active constituents and medicinal uses of crude drugs belonging to various classes of alkaloids, including;

i. Pyridine-Piperidine Alkaloids: Areca, Tobacco
ii. Tropane Alkaloids: Belladonna, Hyoscyamus, Datura
iii. Quinoline Alkaloids: Cinchona
iv. Isoquinoline Alkaloids: Opium, Ipecac, Berberis
v. Indole alkaloids: Catharanthus, Rauwolfia, Ergot
vi. Imidazole alkaloids: Pilocarpus
vii. Steroidal alkaloids: Aconite, Ashwagandha
viii. Alkaloidal Amines: Ephedra, Colchicum
ix. Purine Bases: Tea, Coffee

4. Marine Natural Products

i. Definition, introduction, historical perspective and present status
ii. Classification of important bioactive agents from marine sources
iii. Chemistry and biology of marine natural products
iv. General methods of collection, extraction, isolation and purification
v. Marine compounds with cardio vascular, antispasmodic, anticoagulants and antimicrobial activities

Recommended Reading

1. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson, E. M. (2017). Fundamentals of Pharmacognosy and Phytotherapy. Elsevier Health Sciences.
2. Evans, W. C. (2020). Trease and Evans' Pharmacognosy (17thed), Saunders.
3. Tyler, V. E., Brady, L. R., & Robbers, J.E. (1988). Pharmacognosy (9thed.). Philadelphia, PA: Lea & Febiger.
4. Wallis, T. E. (2005). Textbook of Pharmacognosy (5thed.). CBS Publishers & Distributors.
5. Hussain, A., & Qarshi, I. A. (2022). Medicinal Plants of Qarshi Botanical Garden. Qarshi University Lahore.
6. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
7. Shah, B. (2019). Textbook of Pharmacognosy & Phytochemistry (2nded.). Elsevier.
8. Fattorusso, E., Gerwick, W.H., &Taglialatela-Scafati, O. (2012). Handbook of Marine Natural Products. Springer.
9. Sha, C. L. (2024). Pharmacological Potential of Marine Natural Products. MDPI.

PHG-416 | Cr. Hrs. 1

Pharmacognosy (Basic-Lab-II)

Course Learning Outcomes

By the end of this course, students will be able to:

1. Extract major phytoconstituent classes—carbohydrates, tannins, resins, volatile oils, glycosides, and alkaloids—from crude drugs using appropriate laboratory techniques.
2. Identify these phytoconstituents through characteristic qualitative chemical tests and diagnostic reactions.

Contents

The practicals of the subject shall be designed from time to time based on the above-mentioned theoretical topics and the availability of the facilities.

1. Extraction and chemical identification of phytoconstituents of crude drugs, containing carbohydrates, tannins, resins, volatile oils, glycosides and alkaloids.

(Minimum of 10 practicals will be conducted)
Note: A study tour will be an integral part of the syllabus and will be arranged before the end of the session to collect medicinal plants from the country, and a herbarium sheet will be prepared.

Recommended Reading

1. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson, E. M. (2017). Fundamentals of Pharmacognosy and Phytotherapy. Elsevier Health Sciences.
2. Evans, W. C. (2020). Trease and Evans' Pharmacognosy (17thed), Saunders.
3. Tyler, V. E., Brady, L. R., & Robbers, J.E. (1988). Pharmacognosy (9thed.). Philadelphia, PA: Lea & Febiger.
4. Wallis, T. E. (2005). Textbook of Pharmacognosy (5thed.). CBS Publishers & Distributors.
5. Hussain, A., & Qarshi, I. A. (2022). Medicinal Plants of Qarshi Botanical Garden. Qarshi University Lahore.
6. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
7. Shah, B. (2019). Textbook of Pharmacognosy & Phytochemistry (2nded.). Elsevier.
8. Fattorusso, E., Gerwick, W.H., &Taglialatela-Scafati, O. (2012). Handbook of Marine Natural Products. Springer.
9. Sha, C. L. (2024). Pharmacological Potential of Marine Natural Products. MDPI.

PHG-420 | Cr. Hrs. 2

Pakistan Studies

Course Learning Outcomes

By the end of this course, student will be able to:

1. Have enhanced knowledge of the geographical, historical and political aspects of Pakistan.
2. Understand the society and culture of Pakistan.
3. Understand and explain the socio-economic development in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

Contents

1. **Introduction to Pakistan**
   - Geographical location and significance
   - Historical background: Ancient civilization in the region.
   - Factors leading to the creation of Pakistan.

2. **Political History to Pakistan**
   - Formative Phase
   - Military interventions and democratic transitions

3. **Geography of Pakistan**
   - Physiography: Mountains, Plains, Plateaus, deserts, valleys and coastal areas.
   - River system: Indus River and its tributaries.
   - Climatic regions of Pakistan.

4. **Society and culture of Pakistan**
   - Socio-culture diversity.
   - Languages and Literatures of Pakistan

5. **Economic Development of Pakistan**
   - Agriculture and Industrial sectors of Pakistan.
   - Economic challenges of Pakistan.

6. **Contemporary Issues**
   - Foreign relations of Pakistan.
   - Security challenges: terrorism, extremism and regional conflicts.
   - Environmental problems and sustainable development.
   - Media social change

Recommended Reading

1. Jinnah of Pakistan by "Stanley Wolpert"
2. "The Sole Spoken: Jinnah. The Muslim League and the Demand for Pakistan" by Ayesha Jalal.
3. "The struggle for Pakistan" by Ishtiaq Husain Qureshi.
4. "Pakistan. The Formative Phase, 1857-1948" by Khalid B. Syeed.
5. Pakistan Studies: A Book of Readings" by Sikandar Hayat
6. "Constitutional and Political History of Pakistan" by Hamid Khan
7. "Trek of Pakistan" by Ahmad Saeed and Kh. Mansur Sarwar
8. "Pakistan: A modern history" by Ian Talbot
9. "Polities in Pakistan: The nature and Direction of Change" by Khalid B. Sayeed.
10. "Physical Geography of Pakistan" by Umar Jahangir
11. "A Geography of Pakistan: Environment, People and Economy" by Fazle Karim Khan
12. "Pakistan's Foreign Policy: An Historical Analysis" by S. M. Burke
13. "Separatism in East Pakistan" by Rizwan Ullah Kokab
14. "Being Pakistani: Society, Culture and the Arts" by Raza Rumi
15. "Pakistan Cultural Heritage: Socio-Economic and Technology Aspects" edited by Abdul Jabbar khan
16. "Language and Politics in Pakistan" by Tariq Rahman
17. "Sociology" by Horton and Hunt
18. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring
19. "Economic Development of Pakistan" by Ishrat Husain
20. "Issues in Pakistan's Economy" by S. Zaidi.

PHG-510 | Cr. Hrs. 3

Pharmacognosy (Advanced)

Course Learning Outcomes

After completing this course, students will be able to:

1. Learn the clinical efficacy, mechanisms of action, dosage, and safety profiles of herbal drugs used in treating various ailments, including infectious, renal, cardiac, respiratory, CNS, and reproductive disorders.
2. To get insight into the industrial applications of Pharmacognosy by explaining the formulation, production technologies, and regulatory frameworks involved in the development and commercialization of herbal medicinal products.
3. To apply standard analytical and regulatory methodologies for the evaluation, quality control, and standardization of raw materials and finished herbal formulations by official standards.
4. Understand the role, formulation, and health benefits of Nutraceuticals and natural cosmetics, with the active constituents and excipients.
5. Equip with skills in physicochemical evaluation and quantitative analysis of phytoconstituents in herbal materials and formulations through practical sessions.

Contents

1. **Natural Medicine Practice-II**
   i. Learn the clinical efficacy, mechanisms of action, dosage, and safety profiles of herbal drugs used in treating various ailments, including infectious, renal, cardiac, respiratory, CNS, and reproductive disorders.
      - Infectious diseases: *Allium sativum, Azadirachta indica, Curcuma longa, Melaleucaa lternifolia, Glycyrrhiza glabra*
      - Renal disorders: *Cucumis melo, Zea mays, Berberis vulgaris, Vacciniumm acrocarpon*
      - Tumor/Cancer: *Catharanthus roseus, Podophyllum peltatum, Begoniam alabarica, Taxus brevifolia*
      - Cardiac diseases: *Digitalis, Allium sativum, Strophanthus kombe, Urgenia indica, Punica granatum*
      - Respiratory diseases: *Ephedra sinica, Monis nigra, Ficus religiosa, Glycyrrhiza glabra, Hedera helix*

- CNS disorders: *Erythroxylum coca, Atropa belladonna, Cannabis sativa*
- Reproductive disorders: *Withania somnifera, Vitex agnus-castus, Tribulus terrestris, Oenothera biennis*

ii. Herbal drug interactions
iii. Natural toxins

2. Industrial Pharmacognosy
i. Introduction, scope and applications of industrial pharmacognosy
ii. Evolution of modern natural pharmaceuticals
iii. Infrastructure of the herbal drug industry as per regulatory requirements
iv. Specialized technology used for the preparation of herbal products
v. Dosage forms and drug design for various natural medicines
vi. Conventional medicinal preparations including herbal teas, candies and distillates
vii. Incompatibilities in herbal formulations
viii. Export potential of Pakistani herbs and herbal products

3. Quality Control and Standardization of Herbal Drugs
i. Introduction to evaluation, quality control and standardization
ii. Pharmacopoeial/official standards for herbal products
iii. Challenges in quality control of herbal drugs
iv. Standardization of raw materials and extracts
v. Quality control methods for various herbal drugs
vi. Stability testing of primary and secondary herbal products
vii. Role of marker and reference compounds in the evaluation of herbal drugs
viii. Analysis of heavy metals and pesticide residues

4. Nutraceuticals and Natural Cosmetics
i. Definition and classification of nutraceuticals
ii. Plants and other sources of Nutraceuticals
iii. Role of secondary metabolites in designing nutraceuticals
iv. Functional ingredients in nutraceuticals
v. Dosage forms of nutraceuticals
vi. Health benefits of nutraceuticals
vii. Introduction and benefits of natural cosmetics
viii. Natural ingredients used as active constituents and excipients in cosmetics
ix. Different dosage forms of natural cosmetics
x. Natural cosmetics for skin care, hair care and makeup

Recommended Reading

1. Benzie, I. F. F., &Wachtel-Galor, S. (2011). Herbal Medicine: Biomolecular and Clinical Aspects (2nd ed.). CRC Press/Taylor & Francis
2. Pizzorno, J. E., & Murray, M. T. (2012). Textbook of Natural Medicine(4thed.). Elsevier.
3. McTaggart, L. A. (2018). Herbal Therapeutics: A Clinical Guide. Springer.
4. Braun, L. (2009). Clinical Guide to Herbal Medicine. Elsevier.
5. Kalia, A. N. (2023). Textbook of Industrial Pharmacognosy (14threprint). CBS Publishers & Distributors.
6. Gandla, K., Sayyada, S. Momina, K., & Suresh, K. (2024). Textbook of Industrial Pharmacognosy. BFC Publications Private Limited.
7. Mukherjee, P. K. (2019). Quality Control and Evaluation of Herbal Drugs: Evaluating Natural Products and Traditional Medicine. Elsevier.
8. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
9. Roberts, A. J., O'Brien, M. E., &Subak-Sharpe, G. J. (2001). Nutraceuticals: The Complete Encyclopedia of Supplements, Herbs, Vitamins, and Healing Foods. Berkley Publishing Group.
10. Balakrishnan, P., & Gopi, S. (2022). Handbook of Nutraceuticals and Natural Products: Biological, Medicinal, and Nutritional Properties and Applications. Wiley.
11. Kathuria, D., Sharma, A., Verma, M., & Nayik, G. A. (2024). Bioprospecting of Natural Sources for Cosmeceuticals. Royal Society of Chemistry.

PHG-512 | Cr. Hrs. 1

Pharmacognosy (Advanced)Lab

Course Learning Outcomes

After completing this course, students will be able to:

1. Perform physicochemical analyses of crude drugs—including moisture content, ash values, extractive values, swelling index, and foaming index—using standard pharmacopoeial methods.
2. Conduct quantitative assays to determine the levels of major phytoconstituents in crude extracts and herbal formulations.
3. Interpret and document physicochemical and quantitative data to assess the quality, purity, and standardization of crude drugs and herbal products.

Contents

The practicals of the subject shall be designed from time to time based on the above-mentioned theoretical topics and the availability of the facilities. It may include

1. Evaluation of crude drugs for their physicochemical parameters, including moisture contents, ash values, extractive values, swelling index, and foaming index
2. Quantitative determination (assay) of phytoconstituents in crude extracts and herbal formulations.

(Minimum of 10 practicals will be conducted)
Note: A study tour to a well-renowned herbal or nutraceutical industry from the country will be an integral part of the syllabus and will be arranged before the end of the session, and a report will be submitted.

Recommended Reading

1. Benzie, I. F. F., &Wachtel-Galor, S. (2011). Herbal Medicine: Biomolecular and Clinical Aspects (2nd ed.). CRC Press/Taylor & Francis.
2. Pizzorno, J. E., & Murray, M. T. (2012). Textbook of Natural Medicine(4thed.). Elsevier.
3. McTaggart, L. A. (2018). Herbal Therapeutics: A Clinical Guide. Springer.
4. Braun, L. (2009). Clinical Guide to Herbal Medicine. Elsevier.
5. Kalia, A. N. (2023). Textbook of Industrial Pharmacognosy (14threprint). CBS Publishers & Distributors.
6. Gandla, K., Sayyada, S. Momina, K., & Suresh, K. (2024). Textbook of Industrial Pharmacognosy. BFC Publications Private Limited.
7. Mukherjee, P. K. (2019). Quality Control and Evaluation of Herbal Drugs: Evaluating Natural Products and Traditional Medicine. Elsevier.
8. Rasool, S. (2024). Textbook of Pharmacognosy, theory and practicals. CNC Publisher.
9. Roberts, A. J., O'Brien, M. E., &Subak-Sharpe, G. J. (2001). Nutraceuticals: The Complete Encyclopedia of Supplements, Herbs, Vitamins, and Healing Foods. Berkley Publishing Group.
10. Balakrishnan, P., & Gopi, S. (2022). Handbook of Nutraceuticals and Natural Products: Biological, Medicinal, and Nutritional Properties and Applications. Wiley.
11. Kathuria, D., Sharma, A., Verma, M., & Nayik, G. A. (2024). Bioprospecting of Natural Sources for Cosmeceuticals. Royal Society of Chemistry.

Courses Schedule
Pharm. D. (Deficiency) Program

1st Semester			2nd Semester		
Course NO.	**Title of Course**	**Cr. Hrs.**	**Course NO.**	**Title of Course**	**Cr. Hrs.**
PHG - 713(D)	Clinical Pharmacognosy	2	PHG - 514(D)	Natural Toxicants	2
Total **02 courses**, making **04 Credit hours** in one year					

Pharm. D. Deficiency Courses - Outline
First Semester

PHG-713(D) | Cr. Hrs. 2

Clinical Pharmacognosy

1. **Introduction to clinical Pharmacognosy**
   General introduction and historical background of clinical Pharmacognosy. Study of causes, pathogenesis, clinical features (sign and symptoms), diagnosis, prognosis, prevention and epidemiology of chronic diseases; principles of medication, treatment by herbal medicines.

2. **Clinical Use of herbal medicine**
   Diabetes: *Gymnema sylvestre, Melia azadirchta, Momordica charantia, Syzygium jambulana.*
   Cardiac diseases: *Digitalis spp., Convallaria majalis, Urgenia indica, Allium sativum, Punica granatum.*
   Hepatitis: *Berberis vulgaris, Picrorhiza kurroa, Lawsonia innermis.*
   Respiratory diseases: *Ficus religiosa, Adhatoda vasica.*
   Skin diseases: *Aloe vera, Angelica archangelica, Mentha piperita, Citrus spp., Commiphora mukul.*
   CNS disorders: *Strychnos nux-vomica, Datura stramonium, Cannabis sativa, Papaver somniferum, Atropa belladonna.*
   Musculo-skeletal disorders: *Nigella sativa, Phycotis ajowan, Trigonella foenum-graecum, Zingiber officinale.*
   Renal disorders: *Cucumis melo, Berberis vulgaris, Zea mays, Tribulus terrestris.*
   Reproductive disorders: *Saraca indica, Ruta graveolens, Nigella sativa, Glycyrrhiza glabra, Claviceps purpurea Myristica fragrance.*
   G.I.T. disorders: *Foeniculum vulgare, Ferula foetida, Cuminum cyminum, Aegle marmelos, Prunus domestica.*

Recommended Reading

1. Bone, K., & Mills, S. (2013). Principles and practice of phytotherapy: Modern herbal medicine (2nd ed.). Churchill Livingstone.
2. Pullaiah, T. (2006). Encyclopedia of world medicinal plants (Vol. 5). Regency Publications.
3. Williamson, E. M., Okpako, D. T., & Evans, F. J. (1996). Pharmacological methods in phytotherapy research: Selection, preparation and pharmacological evaluation of plant material (Vol. 1). Wiley.
4. Yadav, A. V., Yadav, B. V., & Shaikh, T. I. (2008). Handbook of clinical pharmacy. Nirali Prakashan.
5. Zhang, L., & Demain, A. L. (Eds.). (2005). Natural products: Drug discovery and therapeutic medicine. Humana Press.

Pharm. D. Deficiency Courses - Outline
Second Semester

PHG-514(D) | Cr. Hrs. 2

Natural Toxicants

1. **General introduction to plant toxicology**
   Classification and chemical nature of natural toxins and toxicities in humans and animals.

2. **Higher plant toxins**
   Essential oils: Terpene (cineol, pine oil), Phenyl propane (apiol, safrole, myristicin), Monoterpene (thujone, menthafuran) Plant acids (oxalic acid, amino acid, resin acid), Glycosides (cardiotonic, cyanognic glycosides), Alkaloids (imidazole, pyrrolizidine, tropane).

3. **Lower plant toxins**
   Bacterial toxins (*Staphylococcus aureus, Clostridium botulinum)*, Algal toxins *(Microcystis aeruginosa,* Cyanobecteria, *Gonyaulax cantenella).*

4. **Mycotoxins**
   Fungal toxins *(Aspergillus spp., Claviceps purpurea),* Mushrooms *(Amanita spp.).*

5. **Study of toxins, their prevention and control methods**
   Description, pharmacognostic features, pharmacological actions, chemical constituents, treatment, side-effects, contra-indications, warnings, prevention and control methods of *Abrus precatorius, Papaver somniferum, Eucalyptus* spp., *Nicotiana tabaccum, Cannabis sativa, Digitalis purpurea, Datura stramonium* poisoning.

Recommended Reading

1. Askari, S. H. A. (2010). *Poisonous plants of Pakistan*. Oxford University Press.
2. Forhne, D., & Pfander, H. J. (2005). *Poisonous plants: A handbook for doctors, pharmacists, toxicologists, biologists and veterinarians* (2nd ed.). Manson Publishing.
3. Gopalakrishnakone, P., Carlini, C. R., & Ligabue-Braun, R. (Eds.). (2017). *Plant toxins* (1st ed.). Springer.
4. Gopalakrishnakone, P., Stiles, B., Alape-Girón, A., Dubreuil, J. D., & Mandal, M. (Eds.). (2018). *Microbial toxins* (1st ed.). Springer.
5. Hildebrandt, J.-P., Teuscher, E., & Lindequist, U. (2023). *Natural poisons and venoms: Animal toxins* (Vol. 4). Walter de Gruyter. https://doi.org/10.1515/9783110728552
6. Mtewa, A. G., Egbuna, C., & Rao, G. M. N. (Eds.). (2020). *Poisonous plants and phytochemicals in drug discovery.* John Wiley & Sons Ltd.

FACULTY OF
Pharmacy and
Pharmaceutical
Sciences

Department of
Pharmacy Practice

Message

The Coordinator, Department of Pharmacy Practice

Dear Students,

As the Professor and Coordinator of the Department of Pharmacy Practice, I am delighted to welcome you to the Pharm.D. program. Pharmacy practice stands as a cornerstone of contemporary healthcare, integrating scientific expertise with direct patient care to promote safe and effective medication use.

Our curriculum is designed with a strong focus on clinical education, covering both hospital and community pharmacy. It includes mandatory hands-on training across various hospitals and community pharmacies in the city, where you will engage with real patients under the supervision of registered pharmacists. Through this practical exposure, you will develop essential competencies in pharmacotherapy and evidence-based medication management, preparing you for meaningful and impactful roles within the healthcare system.

We are equally committed to connecting you with experienced practitioners throughout Karachi, offering valuable mentorship and career development opportunities. Our faculty and team remain dedicated to supporting and guiding you at every step of your academic journey.

The updated pharmacy curriculum now encompasses all key elements required to meet the evolving demands of modern pharmacy practice at both national and international levels. I encourage you to seize this opportunity to become compassionate, skilled pharmacists ready to make a significant difference in healthcare.

Sincerely,

Prof. Dr. Iyad Naeem Muhammad

Coordinat

Department of Pharmacy Practice

As there was an international paradigm shift in the pharmacy orientation from pill to patient, the regulatory body for pharmacy profession, Pharmacy Council of Pakistan had to revisit its curricula. As a result of which, a department of Pharmacy Practice was added peculiarly to focus on the pharmaceutical care practices. Pharmacy practice department in the faculty of Pharmacy and Pharmaceutical Sciences aims to impart and acquaint the students of pharmacy to the standards of practices in pharmaceutical care to obtain the best therapeutic outcomes in order to improve the patient's quality of life. The courses in the department emphasizes on right from the basics of the health in a society to a complex direct patient care at the patients' bed side. It includes the fundamentals of the pharmacy practice, introduces the students to the practice aspects and explore the insights of the practical approach that covers medication error reporting, Adverse Drug Reactions, Drug interactions, Therapeutic Drug Monitoring, institutional and non-institutional pharmacy practices

The need of the real time practices is also part of the curricula that requires the students to get involved in trainings, internships and clerkships in hospital setups. To meet the demand of the courses, faculty of pharmacy and pharmaceutical sciences has signed MoUs with several tertiary care general and specialist hospitals of the city where the students would learn the aspects by practicing under the supervision of skilled professionals. The mission statement of the Department of Pharmacy Practice is to produce highly qualified pharmacists, for Hospital, Community setups, researchers and leaders able to manage in diverse environments and to ultimately improve health in the society.

The Department of Pharmacy Practice, as a future perspective, will not only produce competent pharmacists but will also proceed with the vision of active research in different areas of Pharmacy Practices by offering post graduate programs.

Contact Details:
Telephone: **(+92-21) 99261100**
email: **pharmacypractice@uok.edu.pk**
website: **https://www.uok.edu.pk/faculties/pharmacypractice/index.php**

Department of **Pharmacy Practice**

Vision

"To emerge as a nationally and internationally acclaimed center of excellence in pharmacy practice education, research, and professional service; dedicated to the development of competent, ethical, and innovative pharmacists who will advance patient care, promote the rational use of medicines, and contribute meaningfully to the improvement of public health and the healthcare system at large."

Mission

"The Department of Pharmacy Practice, Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi, is committed to providing high-quality education and training through innovative pedagogy, evidence-based practice, and experiential learning. We aim to foster professional integrity, and a culture of lifelong learning among our students. Through impactful research, interprofessional collaboration, and community engagement, we strive to address healthcare challenges, enhance pharmaceutical services, and promote safe, effective, and fair access to pharmaceutical care for all."

Dr. Iyad Naeem Muhammad

Professor and Coordinator

Qualification
Ph.D., M.Phil., B.Pharm.
(University of Karachi)

Year of Association
2006

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iyadnaeem@uok.edu.pk

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(+92-21) 99261100,
+92-3332361360

Dr. Iyad Naeem joined the Faculty of Pharmacy in 2006, after over five years' experience as a hospital pharmacist. He holds a Ph.D. in Pharmaceutics from University of Karachi, specializing in formulation development, optimization, and population pharmacokinetics, along with an M.Phil. focusing on antimicrobial resistance and nosocomial infections. Currently he is Professor, teaching undergraduate and postgraduate courses in Dosage Forms, Pharmaceutical Quality Control, Forensic Pharmacy, and Hospital Pharmacy. His research interests include Pharmaceutical Microbiology, Formulation Development, and Pharmacy Practice, and he has supervised numerous graduate students in related fields.

Board of Studies

Dr. Muhammad Harris Shoaib
Professor and Dean, (In-Chair)
Faculty of Pharmacy & Pharmaceutical Sciences,
University of Karachi.

Dr. Muhammad Ali Sheraz
Professor, Chairman and Director
Department of Pharmacy Practice
Baqai Institute of Pharmaceutical Sciences,
Baqai Medical University, Karachi.

Dr. Arif Sabah
Associate Professor and Chairman
Department of Pharmacy Practice
Faculty of Pharmacy
Ziauddin University, Karachi

Samina Badar, R. Ph.
Manager Pharmacy
Shaukat Khanum Memorial Cancer Hospital
KDC&C, Karachi

Dr. Rabia Ismail
Professor
Department of Pharmaceutics-
Pharmacy Practice
University of Karachi.

Dr. Iyad Naeem Muhammad
Professor and Coordinator
Department of Pharmacy Practice
University of Karachi.

Pharm. D. Courses
First Semester

Course NO.	Course Title	Cr. Hrs.	Category
Third Professional			
PHP-513	Social and Administrative Pharmacy I	2	Core
Fourth Professional			
PHP-609	Clinical Pharmacy I	3	Core
PHP-611	Clinical Pharmacy (Lab) - I	1	Core
Fifth Professional			
PHP-715	Advanced Clinical Pharmacy I	3	Core
PHP-717	Advanced Clinical Pharmacy I (Lab)	1	Core
PHP-719	Pharmaceutical Regulatory Science - I	3	Core

Pharm. D. Courses
Second Semester

Course NO.	Course Title	Cr. Hrs.	Category
Third Professional			
PHP-514	Social and Administrative Pharmacy II	2	Core
Fourth Professional			
PHP-614	Clinical Pharmacy – II	3	Core
PHP-616	Clinical Pharmacy - II (Lab)	1	Core
PHP-618	Civics and Community Engagement	1	General Edu.
PHP-620	Civics and Community Engagement (Lab)	1	General Edu.
PHP-622	Pharmacy Practice Experience, PPE (Clinical Clerkship)	3	Core
Fifth Professional			
PHP-710	Advanced Clinical Pharmacy II	3	Core
PHP-712	Advanced Clinical Pharmacy II (Lab)	1	Core
PHP-714	Pharmaceutical Regulatory Science - II	3	Core
Total **15 Courses** worth **31 Credit Hours** in five years			

Pharm. D. Courses – Outline
First Semester

PHP-513 | Cr. Hrs. 2

Social and Administrative Pharmacy I

Course Learning Outcomes

At the end of the course the student shall be able to:

1. Analyze the structure of pharmacy services within the Pakistani healthcare system, understand the roles of pharmacists in various settings and public health, and apply the minimum standards for hospital and community pharmacy practice.
2. Evaluate medication management and use processes, identify potential risks, propose mitigation strategies based on the best international practices and regulatory requirements, and understand the role of technology in enhancing medication safety.
3. Apply regulatory requirements to pharmacy operations, develop strategies for formulary management, implement inventory control systems, understand pharmacoeconomic principles, and describe the function of a Pharmacy and Therapeutics Committee.
3. Describe the processes for the selection and procurement of therapeutic goods, manage the pharmaceutical supply chain effectively, implement proper medication storage practices for various drug types, and evaluate medication orders for appropriateness to ensure patient safety, utilizing evidence-based practices and clinical decision support systems.

Contents

1. **Health and Types of health, determinants of health, Fundamentals of healthy society, Pharmacy Practice and Pharmacy Services & Healthcare System in Pakistan:**
   Overview of hospital and community pharmacy setup and organogram. Hospital and community pharmacy services, the Pakistani healthcare system, and the pharmacist's role in various settings and public health.

2. **Minimum Service Standards:**
   Understanding the mandatory standards for both hospital and community pharmacy operations in Pakistan, DRAP Guidelines.

3. **Medication Orders & Prescription Review:**
   Different types of medication orders, the importance of prescription appropriateness review for patient safety, pharmacy clinical interventions, patient care plans, evidence-based practices, and clinical decision support systems (CDSS). Dispensation algorithm in hospital and community pharmacy.

4. **Safe Medication Use Processes, Medication Management and Use (MMU):**
   Introduction to safe medication practices, risk assessment, mitigation strategies, and alignment with international standards (JCI, ISMP, WHO).

5. **Technology in Medication Management:**
   Exploring the use of modern software and technology to enhance medication management and use processes.

6. **Regulatory Compliance & Inventory Management:**
   Understanding regulations, formulary management, inventory control (PAR levels, EOQ, TOR), and the Medication Management System (MMS).

7. **Pharmacy and Therapeutics Committee P&TC:**
   Composition and Function, working Pharmacoeconomics & P&TC: Introduction to pharmacoeconomics,

cost-effective initiatives, and the function of the Pharmacy and Therapeutics Committee.

8. **Therapeutic Goods Selection & Procurement:**
   Criteria for selecting medications and understanding the procurement processes in both public and private sectors, including regulatory requirements.

9. **Supply Chain Management:**
   Management of the pharmaceutical supply chain, including cold chain, narcotics control, diversion prevention, and expiry/BUD management.

10. **Good Medication Storage Practices:**
    Understanding and implementing proper storage conditions (temperature, humidity) and specific protocols for High Alert, LASARA, Concentrated Electrolytes, and Hazardous medications.

Recommended Reading

1. Hospital Pharmacy (3rd Edition); Editors: Raliat Onatade & Martin Stephens; Publisher: Pharmaceutical Press; Publication Date: January 9, 2025
2. Hospital and Community Pharmacy: Comprehensive Guide for Professional Practice Authors: Prof. S. Shobha Rani & Dr. A. Muralidhar Rao; Publisher: Notion Press Publication Date: May 20, 2024
3. Advanced Pharmacy Practice (3rd Edition) Author: Anita Lambert; Publisher: Cengage; Publication Date: 2024
4. Whittlesea, C., & Hodson, K. (Eds.). (2024). *Clinical pharmacy and therapeutics* (6th Ed.). Elsevier.
5. Wick, J. Y. (2024). *Pharmacy practice in an aging society* (2nd Ed.). Routledge.
6. Cipolle, R. J., Strand, L. M., & Morley, P. C. (2012). Pharmaceutical care practice: The patient-centered approach to medication management services (3rd ed.). McGraw Hill.
7. DRAP Guidelines on Minimum Standards for Establishment of Hospital pharmacies in Pakistan.

PHP-609 | Cr. Hrs. 3

Clinical Pharmacy – I

Course Learning Outcomes

At the end of the course, students should be able to:

1. Explain the fundamentals of clinical pharmacy and describe the roles of clinical pharmacists in patient care and public health.
2. Interpret and apply information from medication history and patient profiles to optimize medication therapy.
3. Identify and manage adverse drug reactions, drug interactions, medication errors, and therapeutic drug levels using standard tools and guidelines.
4. Demonstrate a basic understanding of clinical trials and evaluate clinical literature to promote evidence-based pharmacy practice.

Contents

1. **Fundamentals of Clinical Pharmacy:**
   (1)Definition and scope of clinical pharmacy, relationship between pharmaceutical care and clinical pharmacy (2) Impact of clinical pharmacy on healthcare systems and patient outcomes (3) Evolution of clinical pharmacy in Pakistan, including the transition from a dispensing-focused role to patient-centered care (4) Overview of the various roles and responsibilities of clinical pharmacists, including their functions in diverse healthcare settings such as hospitals, ambulatory care, community pharmacies, clinics, and nursing homes.

2. **Comprehensive Patient Assessment and Therapy Optimization through Patient Data:**
   (1)Patient clinical profile, including case history: basic understanding by pharmacists and their applications in pharmaceutical care (2) Taking medication history: components, techniques, applications (3) Clinical labs tests monitoring by pharmacists and their application in optimizing medication therapy.

3. **Medication Safety and Health Informatics: Systems Approach to Safe Medication Use:**
(1) *Importance of Medication Safety in Healthcare,* (2) *Medication Errors*: Definition and types, (3) *Near-Misses*, (4) *High-Risk Medicines*: Look-Alike Sound-Alike (LASA) medicines, High-Alert Medication (HAM) protocols, and risk mitigation strategies, (5) *Safety Standards/Guidelines:* Institute for Safe Medication Practices (ISMP), World Health Organization (WHO), International Patient Safety Goals (IPSG), and hospital protocols, (6) *Informatics Tools:* Electronic Health Record (EHR), Computerized Physician Order Entry (CPOE), Clinical Decision Support System (CDSS), Barcoded Medication Administration (BCMA), and smart infusion pumps, (7) *Approaches for Analysis and Prevention:* Swiss Cheese Model for error prevention, process vulnerabilities, Root Cause Analysis (RCA), and Failure Modes and Effects Analysis (FMEA), (8) *Reporting of Medication Errors:* Voluntary and mandatory systems, (9) *Quality Improvement:* Key Performance Indicators (KPIs), Plan-Do-Study-Act (PDSA) cycles, Lean methodology, and Six Sigma methodology, (10) *Pharmacist's Role:* Safety leadership, policy input, and compliance with guidelines.

4. **Pharmacovigilance and Adverse Drug Reactions: Clinical Surveillance, Reporting, and Management:**
(1)*Pharmacovigilance:* Definition, scope, and applications; (2) *Adverse Drug Reactions (ADRs):* Definition and classification (Rawlins & Thompson; DoTS); assessment and grading of ADR severity; onset of ADRs; (3) *Main Mechanisms of ADRs:* Excessive primary pharmacological effects, secondary pharmacological effects, allergic (immunological) reactions, and idiosyncratic reactions; (4) *Monitoring and Detection of ADRs;* (5) *Reporting*: Definition of adverse drug events (ADEs); differentiation between ADEs and ADRs; reporting forms; reporting at local, national, and international levels (WHO-UMC), including the Spontaneous Reporting System; (6) *Causality Assessment:* WHO-UMC system and Naranjo algorithm; (7) *Management of ADRs*.

5. **Drug Interactions: Assessment, Evaluation and Management:**
(1)Introduction and clinical significance of drug interactions; (2) Mechanisms and Types; (3) Factors affecting drug interactions; (4) Levels of drug interactions (severity, onset, documentation); (5) Identification, clinical evaluation and management of drug interactions.

6. **Therapeutic Drug Monitoring (TDM):**
(1)The concept of narrow therapeutic index drugs and the importance of therapeutic drug monitoring (2) TDM of digoxin, theophylline, gentamicin, vancomycin, lithium, phenytoin, carbamazepine, valproate, cyclosporine, tacrolimus, and sirolimus.

7. **Clinical Trials of Drug Substances:**
(1)Introduction; (2) Why clinical trials are needed; (3) Phases of clinical trials; (4) Various designs used in clinical trials; (5) Inclusion and exclusion criteria; (6) Monitoring of clinical trials.

8. **Utilizing Clinical Drug Literature:**
(1)Introduction; (2) Drug literature selection; (3) Drug literature evaluation; (4) Drug literature communication.

9. **Clinical Pharmacy and Public Health:**
(Recognizing the pharmacist's role in health promotion, disease prevention and screening, lifestyle counseling, immunization, pharmacoepidemiology, public health emergencies (pandemics and disasters), with an emphasis on collaboration with healthcare teams, policy involvement, and community-based interventions to enhance public health outcomes.

Recommended Reading

1. Walker, R., & Whittlesea, C. (2019). Clinical pharmacy and therapeutics (6th ed.). Churchill Livingstone/Elsevier.
2. DiPiro, J. T., Yee, G. C., Posey, L. M., Haines, S. T., Nolin, T. D., & Ellingrod, V. L. (2023). Pharmacotherapy: A pathophysiologic approach (12th ed.). McGraw Hill.
3. Schwinghammer, T. L., DiPiro, J. T., DiPiro, C. V., & Ellingrod, V. L. (2023). DiPiro's pharmacotherapy handbook (12th ed.). McGraw Hill.
4. Gupta, V., Nguyen, T., Clark, M., Williams, E., Cone, C., & Desselle, S. (2022). Pharmacy practice skills: A guide for students and instructors (2nd ed.). McGraw Hill.
5. Jones, R. M. (2015). Patient assessment in pharmacy practice (3rd ed.). Lippincott Williams & Wilkins.
6. Nemire, R. E., Kier, K. L., & Assa-Eley, M. T. (2015). Pharmacy student survival guide (3rd ed.). McGraw Hill.
7. Schwinghammer, T. L., Koehler, J. M., Borchert, J. S., Slain, D., & Park, S. K. (2020). Pharmacotherapy casebook: A patient-focused approach (11th ed.). McGraw Hill.
8. Shargel, L., Mutnick, A. H., Souney, P. F., & Swanson, L. N. (2012). Comprehensive pharmacy review for NAPLEX

(9th ed.). Lippincott Williams & Wilkins.
9. Cipolle, R. J., Strand, L. M., & Morley, P. C. (2012). Pharmaceutical care practice: The patient-centered approach to medication management services (3rd ed.). McGraw Hill.
10. Remington, J. P., Troy, D. B., & Beringer, P. (2020). Remington: The science and practice of pharmacy (23rd ed.). Lippincott Williams & Wilkins.
11. Lacy, C. F., Armstrong, L. L., Goldman, M. P., & Lance, L. L. (2024). Drug information handbook (32nd ed.). Lexi-Comp.
12. Anderson, C. E. (2018). Medication safety officer's handbook (2nd ed.). American Society of Health-System Pharmacists.
13. Institute for Safe Medication Practices. (2024). Targeted medication safety; the best practices for hospitals. Institutefor Safe Medication Practices. Retrieved 8 April 2025, from https://psnet.ahrq.gov/issue/targeted-medication-safety-best-practices-hospitals.
14. UpToDate. (Online Database). Clinical decision support for pharmacotherapy. Wolters Kluwer Health. Retrieved 8 April 2025, from https://www.uptodate.com.
15. PharmaGuide® Publishing Company. (2025). PharmaGuide®. (32nd ed.). Karachi, Pakistan.

PHP-611 | Cr. Hrs. 1

Clinical Pharmacy (Lab) - I

Course Learning Outcomes

At the end of the course, students should be able to:

1. Demonstrate the ability to collect, interpret, and apply patient-specific clinical data including medication history, lab values, renal function, and drug levels to identify drug-related problems and support safe, effective pharmacotherapy.
2. Effectively utilize drug information resources, medication safety principles, ADR and interaction assessment tools, and therapeutic drug monitoring to optimize pharmacotherapy and contribute to public health initiatives.

Note:

- Instructors may use a variety of educational strategies based on availability, such as case studies (paper-based or digital), simulated clinical scenarios, standardized patients (SPs), role-play, small- group discussions, problem-based learning (PBL), patient profile reviews, and digital tools to support practical skill development.
- At least 10 practicals must be conducted during the course; however, more are encouraged to enhance practical learning.

Contents

1. Identify components of a comprehensive patient clinical profile.
2. Demonstrate techniques for collecting medication history.
3. Interpret patient case histories for therapy planning.
4. Assess renal function and adjust doses accordingly.
5. Evaluate patient profiles to identify drug-related problems.
6. Interpret laboratory data relevant to pharmacotherapy.
7. Compare different drug information tools/resources.
8. Use drug information resources to answer clinical questions.
9. Apply retrieved drug information to clinical scenarios.
10. Develop lists of drugs frequently prescribed or used in clinical settings, along with their clinical uses.
11. Extract clinical data from patient documentation systems.
12. Classify types and causes of medication errors.
13. Recognize high-alert and look-alike sound-alike medications.
14. Analyze medication use processes using safety models.
15. Demonstrate the use of medication informatics systems.
16. Conduct error analysis using structured evaluation tools.
17. Develop plans for improving medication safety practices.
18. Create performance indicators for medication safety.

19. Classify adverse drug reactions (ADRs) using standard classification systems.
20. Assess causality of ADRs using structured tools.
21. Complete and submit ADR reporting documentation.
22. Formulate a plan for managing adverse drug reactions.
23. Identify and screen drug interactions using various methods and tools.
24. Manage drug interactions in vulnerable patient groups.
25. Interpret and apply serum drug concentrations in therapeutic drug monitoring, considering all relevant clinical factors.
26. Develop a community-based pharmacy plan to address a specific public health issue (e.g., hypertension or diabetes mellitus screening).
27. Search and retrieve relevant clinical drug literature using appropriate databases.

Recommended Reading

1. Walker, R., & Whittlesea, C. (2019). Clinical pharmacy and therapeutics (6th ed.). Churchill Livingstone/Elsevier.
2. DiPiro, J. T., Yee, G. C., Posey, L. M., Haines, S. T., Nolin, T. D., & Ellingrod, V. L. (2023). Pharmacotherapy: A pathophysiologic approach (12th ed.). McGraw Hill.
3. Schwinghammer, T. L., DiPiro, J. T., DiPiro, C. V., & Ellingrod, V. L. (2023). DiPiro's pharmacotherapy handbook (12th ed.). McGraw Hill.
4. Gupta, V., Nguyen, T., Clark, M., Williams, E., Cone, C., & Desselle, S. (2022). Pharmacy practice skills: A guide for students and instructors (2nd ed.). McGraw Hill.
5. Jones, R. M. (2015). Patient assessment in pharmacy practice (3rd ed.). Lippincott Williams & Wilkins.
6. Schwinghammer, T. L., Koehler, J. M., Borchert, J. S., Slain, D., & Park, S. K. (2020). Pharmacotherapy casebook: A patient-focused approach (11th ed.). McGraw Hill.
7. Shargel, L., Mutnick, A. H., Souney, P. F., & Swanson, L. N. (2012). Comprehensive pharmacy review for NAPLEX (9th ed.). Lippincott Williams & Wilkins.
8. Remington, J. P., Troy, D. B., & Beringer, P. (2020). Remington: The science and practice of pharmacy (23rd Ed.). Lippincott Williams & Wilkins.
9. Lacy, C. F., Armstrong, L. L., Goldman, M. P., & Lance, L. L. (2024). Drug information handbook (32nd ed.). Lexi-Comp.
10. Anderson, C. E. (2018). Medication safety officer's handbook (2nd ed.). American Society of Health-System Pharmacists.
11. Institute for Safe Medication Practices. (2024). Targeted medication safety best practices for hospitals.
12. Institutefor Safe Medication Practices. Retrieved 8 April 2025, from https://psnet.ahrq.gov/issue/targeted-medication-safety-best-practices-hospitals.
13. UpToDate. (Online Database). Clinical decision support for pharmacotherapy. Wolters Kluwer Health. Retrieved 8 April 2025, from https://www.uptodate.com.
14. PharmaGuide Publishing Company. (2025). PharmaGuide. (32nd ed.). Karachi, Pakistan.

PHP-715 | Cr. Hrs. 3

Advanced Clinical Pharmacy I

Course Learning Outcomes

At the completion of this course students will be able to

1. Identify individual patient needs and apply this understanding to develop and optimize pharmacotherapy plans that align with those needs. This includes considering patient-specific factors and ensuring the pharmacotherapy regimen is tailored for maximum benefit.
2. Integrate knowledge of disease pathophysiology and etiology with current evidence-based practices to formulate effective pharmacotherapy and comprehensive pharmaceutical care plans. This encompasses making informed clinical decisions grounded in scientific literature and best practice guidelines.
3. Perform thorough medication reconciliation to ensure medication safety and identify patient-specific risk factors that may impede optimal treatment outcomes. This includes the ability to analyze medication histories and recognize potential barriers to successful therapy.

4. Effectively educate and counsel patients on various aspects of their disease management and medications. This includes communicating complex information in an understandable manner, addressing patient concerns, and empowering patients to actively participate in their care.

Contents

1. Common conditions (fever, cough, common cold/flu, pain management, bacterial and viral conjunctivitis, wound care management)
2. Common GIT disorders (Stomach Ulcer, GERD, Diarrhea, Constipation)
3. Chronic diseases (Hyperlipidemia, Diabetes Mellitus, Hypertension, Hyper- and Hypothyroidism)
4. Dermatological infections (Bacterial: Folliculitis, Boil, Erysipelas, Impetigo, Cellulitis, Gangrene; Viral: Warts, HPV, Herpes Simplex Type 1 and 2; Fungal: Tinea, Ringworm, Athlete's Foot, Jock Itch, Nail Fungus, Oral Thrush)
5. CNS disorders/infections (Epilepsy, Anxiety/Stress, Meningitis, Stroke, Typhoid)

Recommended Reading

1. DiPiro, J. T., Talbert, R. L., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (11 Eds.). (2022). Pharmacotherapy: a pathophysiological approach.
2. Koda-Kimble, M.A. ed., 2007. Handbook of applied therapeutics. Lippincott Williams & Wilkins.
3. DiPiro's Pharmacotherapy Handbook, 12th Edition
4. Chisholm-Burns, Marie A., Terry L. Schwinghammer, Patrick M. Malone, Jill M. Kolesar, Kelly C. Lee, and P. Brandon Bookstaver. Pharmacotherapy principles and practice. McGraw-Hill, 2022.

PHP-717 | Cr. Hrs. 1

Advanced Clinical Pharmacy I (Lab)

Course Learning Outcomes

At the completion of this course students will be able to

1. Develop comprehensive SOAP notes and pharmaceutical care plans for diseases covered in the unit by analyzing simulated or real patient case studies to identify drug-related problems and therapeutic goals.
2. Demonstrate effective patient counseling and education skills by delivering disease-specific information that promotes medication adherence and achievement of optimal therapeutic outcomes.
3. Recommend appropriate dose adjustments, therapeutic alternatives, and non-pharmacological interventions based on patient-specific factors to enhance treatment efficacy and patient well-being.
4. Interpret relevant laboratory values and clinical parameters to identify disease severity, monitor therapy, and propose evidence-based pharmacotherapeutic interventions in accordance with current clinical guidelines.
5. Construct disease-specific clinical flowcharts, including laboratory value interpretation and treatment decision pathways (e.g., meningitis and other CNS disorders), to support systematic clinical reasoning.
6. Collaborate in groups to design and present patient education booths addressing common conditions (e.g., common cold), integrating preventive strategies, treatment options, and medication safety.
7. Create educational handouts or digital presentations (e.g., using Canva or PowerPoint) that outline symptom-management algorithms and promote safe and effective use of over-the-counter (OTC) medications.
8. Apply patient-centered counseling techniques through role-play scenarios, effectively adapting communication strategies to diverse patient populations, including individuals with low health literacy or special needs.
9. Demonstrate professional, goal-oriented communication skills during simulated practice using a model pharmacy, engaging patients to assess needs, address concerns, and support shared decision-making.

Contents

1. Students must be able to prepare SOAP Notes or Pharmaceutical care plan for the disease discussed in this unit. Case studies can be either simulated or real cases depending on availability.
2. Patient counselling and Education to achieve optimum therapeutic goals specific to the diseases covered in this unit.
3. Dose adjustments, Selection of Alternates, Non-Pharmacological measure to improve the therapeutic outcomes and well-being
4. Interpretation of Lab values and identification of suitable interventions as per evidence-based guidelines.
5. For Meningitis (CNS Disorders), students create flowcharts mapping lab values. (In the same way with other diseases.
6. In groups, students design and present educational booths for conditions like the Common Cold (Common Conditions).
7. Create handouts or presentations (e.g., using Canva or ppt) on symptom management (algorithm) and OTC medication safety
8. Role-play counseling diverse "patients" (peers with assigned demographics, e.g., low health literacy).
9. Engagement and goal-oriented communication. Model pharmacy would be used.

Note: (At least 10 labs)

Recommended Reading

1. DiPiro, J. T., Talbert, R. L., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (11 Eds.). (2022). Pharmacotherapy: a pathophysiological approach.
2. Koda-Kimble, M.A. ed., 2007. Handbook of applied therapeutics. Lippincott Williams & Wilkins.
3. DiPiro's Pharmacotherapy Handbook, 12th Edition
4. Chisholm-Burns, Marie A., Terry L. Schwinghammer, Patrick M. Malone, Jill M. Kolesar, Kelly C. Lee, and P. Brandon Bookstaver. Pharmacotherapy principles and practice. McGraw-Hill, 2022.

PHP-719 | Cr. Hrs. 3

Pharmaceutical Regulatory Science - I

Course Learning Outcomes

After the completion of this course students will be able to:

1. Understand the basis of legislation, legislative process; analyze the foundational principles and the significance of pharmaceutical regulations, with a comprehensive understanding of key global and national regulatory bodies.
2. Explain the basis of regulatory functions and the operational processes across the product life cycle for Therapeutic goods.
3. Describe the basic documentation required for regulatory submission and assessment
4. Describe various platforms of regulatory interactions and the major contributions in shaping regulatory approaches and collaborations.

Contents

1. Introduction to Legislative Process/Type of Laws Covers the process of law making, types of laws including Acts, Ordinances, Rules, Regulations etc., difference between criminal and civil laws, judicial structure in Pakistan.
2. History of Drug Regulation in Pakistan— A brief introduction to Drugs Act, 1940 and eras of drug regulation thereafter.
3. An overview of regulatory framework in Pakistan- Covers structure of DRAP, Provincial Drug Controls, various Boards and their functions.
4. An overview of S&F products- Classification of S&F products, their definition and related aspects including investigation functions.
5. Investigation and Prosecution of Drug Offences Covers the definition, scope, and importance of pharmaceutical regulation, focusing on global and national bodies like DRAP (Drug Regulatory Authority of Pakistan).

6. Drugs Act, 1976 – Covering all sections of Drugs Act, 1976, their interpretation and application in regulatory landscape of Pakistan.
7. A brief overview of the Rules framed under the Drugs Act, 1976 with special emphasis on respective provincial sale rules.

Recommended Reading

1. Pharmaceutical Regulatory Affairs – Sachin Itkar (adaptable to local laws)
2. Drug Act, 1976 – Official Government of Pakistan publication
3. Manual of Drug Laws
4. WHO Guidelines for Pharmaceutical Regulations
5. Pakistan Drug Rules 1976 and amendments

Pharm. D. Courses – Outline
Second Semester

PHP-514 | Cr. Hrs. 2
Social and Administrative Pharmacy II

Course Learning Outcomes

At the end of the course the student shall be able to:

1. To analyze the structure of pharmacy services within the Pakistani healthcare system, understand the roles of pharmacists in various settings and public health, and apply the minimum standards for hospital and community pharmacy practice.
2. To evaluate medication management and use processes, identify potential risks, propose mitigation strategies based on the best international practices.
3. To Apply regulatory requirements to pharmacy operations, develop strategies for formulary management, implement inventory control systems, understand pharmacoeconomic principles, and describe the function of a Pharmacy and Therapeutics Committee. t

Contents

1. Reading and transcribing physicians' orders, medical profiles and medication administration records
2. Medication cart filling and documentation
3. Recording and management of narcotic drugs
4. Drug Preparation included Aseptic Services in Hospital Pharmacy
   a. Fundamental learning of drug preparation and dispensing (Aseptic/ Sterile area services in hospital settings and compounding services in hospital and community settings),
   b. Pharmaceutical Calculations: Some Fundamentals of Measurements and Calculations. The Metric System. The Common Systems. Conversions. Calculation of Doses. Percentage calculations, Reducing and Enlarging Formulas. Weights and Volumes of Liquids. HLB Values. Industrial Calculations. Calculations involving parenteral admixtures. Some calculations involving Hydrogen-ion concentration. Calculations involving isotonic, electrolyte and buffer solutions.
   c. Role of pharmacist in radiopharmaceuticals.
   d. Drug Administration, follow up and safety procedures in dispensing
5. Basic of drug administration for safe use of medications, including seven rights of drug administration.
6. Understand the drug devices, drug libraries, and ready to administer mediations
7. Self-administration and home care services.
   a. Education for patients, public and health care professionals.
   b. Evaluation, promote public health and provide education to the patients, public and health care providers.
      i. Understand the patient's need, psychology, behavioral sciences and expectations
      ii. Development of patient education leaflets, and newsletters.

iii. To provide patient education on safe use of antimicrobials, family planning, etc.
iv. Effective medication counselling and drug adherence.
v. Patient feedback / satisfaction survey tools
vi. Drug information services, authentic sources like Lexicomp® etc.

c. Miscellaneous
d. Drug shortages and liaison with prescribers with the best therapeutic alternatives.
e. Managing Pharmaceutical waste and energy sustainable initiatives in pharmacy services.
f. Drug recalls and response to safety alerts
g. Dispensing of extemporaneous preparations
h. Dispensing of Vaccine, and Biologics: EPI program Pakistan, Essential vaccinations for travelling, Counseling and patient education relevant to Vaccination.

Recommended Reading

1. Patient Safety and Healthcare Improvement at a Glance – S. King, P. Greaves
2. Medication Safety Officer's Handbook – C. E. Anderson
3. Clinical Informatics Board Review – S. M. Gadd, R. Chapman
4. ISMP Medication Safety Guidelines – Institute for Safe Medication Practices (ISMP)
5. WHO Patient Safety Curriculum Guide: Multi-professional Edition
6. Relevant journal articles on emerging technologies and trends in medication safety (JAMA, BMJ Safety, AJHP).

PHP-614 | Cr. Hrs. 3

Clinical Pharmacy - II

Course Learning Outcomes

At the end of the course students shall be able to:

1. Develop, implement, and monitor patient-centered drug therapy plans using standardized frameworks, care processes, effective documentation, and evidence-based decision-making.
2. Apply medication management and optimization strategies, including Medication Therapy Management (MTM), Drug Utilization Review (DUR), and antimicrobial stewardship, to promote rational pharmacotherapy.
3. Provide pharmaceutical care across diverse settings using current practices, advanced digital tools, and telepharmacy while maintaining ethical, legal, and professional standards.
4. Improve medication adherence and therapeutic outcomes through appropriate assessment, effective communication, and individualized patient education strategies.

Contents

1. **Pharmacotherapy and Drug Therapy Plans:**
From Foundational Framework to Development and Monitoring: (1) Introduction: Overview of pharmacotherapy and drug therapy plans; essential roles in pharmaceutical care, (2) Pharmacist's Workup of Drug Therapy (PWDT): A foundational framework for pharmacists, (3) Pharmacist Patient Care Process (PPCP): Core components and clinical applications, (4) Drug Therapy Problems (DTPs) / Drug-Related Problems (DRPs): Common categories and integration into drug therapy plans, (5) Drug Therapy Plan: Development, implementation, and monitoring, (6) Clinical Documentation: Importance and principles of effective documentation; common formats: SOAP notes, FARM notes, PRIME pharmacotherapy problems, CORE pharmacotherapy plan, (7) The Role of Drug Therapy Plans in Modern Pharmacy Practice.

2. **Pharmacotherapy Decision-Making:**
(1) Transition from advisor to practitioner, (2) Identify opportunities for decision-making, (3) Proactively engage, (4) Formulate evidence-based decision rationale, (5) Pursue the highest levels of decision-making, (6) Seek independence with accountability, (7) Implement decisions with professional responsibility.

3. **Optimizing Medication Use and Combating Antimicrobial Resistance:**
   Core principles of medication optimization. Antimicrobial resistance (AMR): causes and impact. Antimicrobial stewardship: goals and approaches. WHO AWaRe classification of antibiotics and its clinical applications.

4. **Medication Therapy Management (MTM) Services:**
   Defining the core components and importance of MTM, including medication review, developing Medication-Related Action Plans (MAPs), providing patient education, and effectively identifying and resolving drug-related problems with appropriate documentation and follow-up.

5. **Drug Utilization Evaluation (DUE) and Drug Utilization Review (DUR):**
   Definitions, types, and applications. General methodology for developing drug-use criteria (or drug-use protocols). Development of drug-use criteria for selected drugs such as vancomycin, piperacillin/tazobactam, and meropenem.

6. **Online Pharmaceutical Care Services:**
   Introduction to remote pharmacy services; Core Functions; Technology; Legal/Ethical Considerations; Trends & Challenges.

7. **Provision of Pharmaceutical Care in Multiple Environments:**
   Delivery of pharmaceutical care across multidisciplinary and culturally diverse settings, encompassing variations in language, health literacy, patient needs, and other contextual factors, with a focus on professionalism, ethical practice, and patient-centered outcomes.

8. **Leveraging Advanced Clinical Pharmacy Tools and Technologies:**
   Exploring the integration and application of Electronic Medical Records (EMRs), Clinical Decision Support Systems (CDSS), mobile health (mHealth) applications, smart devices, pharmacogenomics, wearable technologies, and the emerging role of Artificial Intelligence (AI) and machine learning in optimizing pharmacotherapy and advancing personalized medicine.

9. **Medication Adherence:**
   Definition and clinical significance; types of non-adherence; assessment tools; barriers to adherence; and strategies to improve adherence.

10. **Patient Education and Communication:**
    Definitions, core counselling and communication skills, patient-centered care, health literacy assessment, motivational interviewing, targeted communication (pediatric, geriatric, chronic disease populations, specific drugs/dosage forms etc), aids (visual/digital/print), shared decision-making.

Recommended Reading

1. Benedict, K., & Madaras-Kelly, K. (2020). Antimicrobial Stewardship in Pharmacy Practice. American Society of Health-System Pharmacists (ASHP).
2. Hughes, R. E., & Martin, D. (2021). Developing critical thinking in pharmacy students. American Journal of Pharmaceutical Education, 85(5), Article#8539.
3. American Pharmacists Association (APhA) & National Association of Chain Drug Stores Foundation. (2020). Medication Therapy Management in Pharmacy Practice: Core Elements of an MTM Service Model. (12th ed.). APhA & NACDSF.
4. Whalen, K., & Hardin, H. C. (2021). Medication Therapy Management: A Comprehensive Approach (2nd ed.). McGraw Hill.
5. American Society of Health-System Pharmacists (ASHP). (2022). ASHP Statement on Telepharmacy. American Journal of Health-System Pharmacy, 79(5), 381–385.
6. Walker, R., & Whittlesea, C. (2019). Clinical pharmacy and therapeutics (6th ed.). Churchill Livingstone/Elsevier.
7. DiPiro, J. T., Yee, G. C., Posey, L. M., Haines, S. T., Nolin, T. D., & Ellingrod, V. L. (2023). Pharmacotherapy: A pathophysiologic approach (12th ed.). McGraw Hill.
8. Schwinghammer, T. L., DiPiro, J. T., DiPiro, C. V., & Ellingrod, V. L. (2023). DiPiro's pharmacotherapy handbook (12th ed.). McGraw Hill.

9. Gupta, V., Nguyen, T., Clark, M., Williams, E., Cone, C., & Desselle, S. (2022). Pharmacy practice skills: A guide for students and instructors (2nd ed.). McGraw Hill.
10. Jones, R. M. (2015). Patient assessment in pharmacy practice (3rd ed.). Lippincott Williams & Wilkins.
11. Nemire, R. E. (Ed.). (2023). Pharmacy student survival guide (4th ed.). McGraw Hill.
12. Schwinghammer, T. L., Koehler, J. M., Borchert, J. S., Slain, D., & Park, S. K. (2020). Pharmacotherapy casebook: A patient-focused approach (11th ed.). McGraw Hill.
13. Shargel, L., Mutnick, A. H., Souney, P. F., & Swanson, L. N. (2012). Comprehensive pharmacy review for NAPLEX (9th ed.). Lippincott Williams & Wilkins.
14. Cipolle, R. J., Strand, L. M., & Morley, P. C. (2021). Pharmaceutical care practice: The patient-centered approach to medication management services (3rd ed.). New York, NY: McGraw Hill.
15. Remington, J. P., Troy, D. B., & Beringer, P. (2020). Remington: The science and practice of pharmacy (23rd ed.). Lippincott Williams & Wilkins.
16. Lacy, C. F., Armstrong, L. L., Goldman, M. P., & Lance, L. L. (2024). Drug information handbook (32nd ed.). Lexi-Comp.
17. UpToDate. (Online Database). Clinical decision support for pharmacotherapy. Wolters Kluwer Health. Retrieved 8 April 2025, from https://www.uptodate.com.
18. PharmaGuide Publishing Company. (2025). PharmaGuide. (32nd ed.). Karachi, Pakistan.

PHP-616 | Cr. Hrs. 1

Clinical Pharmacy - II (Lab)

Course Learning Outcomes

At the end of the course, students should be able to:

1. Design, implement, monitor, and document individualized drug therapy plans using standardized approaches (e.g., PWDT, PPCP), incorporating clinical data, patient-specific factors, and evidence-based guidelines.
2. Demonstrate effective patient-centered care through communication, patient education, adherence strategies, pharmacotherapy optimization, digital health tools, and the application of medication safety, MTM, and antimicrobial stewardship principles across diverse populations and care settings.

   Note: Instructors may use a variety of educational strategies based on availability, such as case studies (paper-based or digital), simulated clinical scenarios, standardized patients (SPs), role-play, small-group discussions, problem-based learning (PBL), patient profile reviews, and digital tools to support practical skill development.

   At least 10 practicals must be conducted during the course; however, more are encouraged to enhance practical learning.

Contents

1. Develop a comprehensive drug therapy plan using standardized approaches such as the Pharmacist's Workup of Drug Therapy (PWDT) and the Pharmacist Patient Care Process (PPCP).
2. Identify and categorize drug therapy problems (DTPs) in patient profiles and propose appropriate interventions.
3. Develop therapeutic outcome goals and design a structured monitoring plan.
4. Implement a pharmacotherapy plan effectively, considering patient-specific factors, collaboration with healthcare providers, and resource availability.
5. Document pharmacotherapy interventions using formats such as SOAP, FARM, PRIME, or CORE notes.
6. Formulate and justify pharmacotherapy decisions based on evidence-based clinical guidelines and patient-specific data.
7. Assess a patient case and implement evidence-based modifications to therapy.
8. Assess medication adherence using validated tools; analyze contributing factors and classify types of non-adherence.

9. Design and implement individualized strategies to improve medication adherence.
10. Apply patient education and communication strategies suited to the needs of special populations (e.g., pediatrics, geriatrics).
11. Conduct a simulated counseling session using motivational interviewing and shared decision-making techniques.
12. Prepare and deliver a structured patient education session using digital or visual aids.
13. Assess drug safety in pregnancy and lactation and develop an appropriate patient counseling and education plan.
14. Demonstrate appropriate drug administration techniques for various dosage forms and routes, including specialized forms such as inhalers, insulin pens, transdermal patches, nasal sprays, nasal drops, and eye preparations.
15. Educate a patient on proper self-administration of medications using specialized devices (e.g., nebulizers, insulin pens, inhalers), emphasizing correct technique, storage, and error prevention.
16. Educate patients about home-based monitoring of chronic diseases (e.g., diabetes mellitus, hypertension) and advise when to consult healthcare professionals.
17. Evaluate pharmacotherapy in geriatric patients; identify common challenges and propose patient-centered solutions.
18. Review pediatric medication use, including dosing adjustments, formulation issues, and caregiver education.
19. Evaluate antibiotic use in clinical scenarios; propose stewardship strategies and apply the WHO AWaRe classification.
20. Design and document an antimicrobial stewardship intervention based on a clinical case.
21. Perform a complete Medication Therapy Management (MTM) review, including development of a Medication-Related Action Plan (MAP).
22. Identify and resolve drug-related problems in MTM cases with appropriate documentation and follow-up.
23. Conduct a Drug Utilization Review (DUR) or Drug Use Evaluation (DUE) for selected high-risk or high-cost medications.
24. Develop and apply drug-use criteria for selected medications or therapeutic classes.
25. Review and evaluate a telepharmacy case, addressing legal, ethical, and clinical considerations.
26. Develop pharmaceutical care plans for culturally diverse patient populations.
27. Propose a strategy to integrate advanced tools and health technologies into patient care delivery.
28. Demonstrate the use of digital clinical tools (e.g., EMRs, CDSS, mHealth apps) in therapeutic decision-making.

Recommended Reading

1. Benedict, K., & Madaras-Kelly, K. (2020). Antimicrobial Stewardship in Pharmacy Practice. American Society of Health-System Pharmacists (ASHP).
2. Hughes, R. E., & Martin, D. (2021). Developing critical thinking in pharmacy students. American Journal of Pharmaceutical Education, 85(5), Article#8539.
3. American Pharmacists Association (APhA) & National Association of Chain Drug Stores Foundation. (2020). Medication Therapy Management in Pharmacy Practice: Core Elements of an MTM Service Model. (12th ed.). APhA & NACDSF.
4. Whalen, K., & Hardin, H. C. (2021). Medication Therapy Management: A Comprehensive Approach (2nd ed.). McGraw Hill.
5. American Society of Health-System Pharmacists (ASHP). (2022). ASHP Statement on Telepharmacy. American Journal of Health-System Pharmacy, 79(5), 381–385.
6. Walker, R., & Whittlesea, C. (2019). Clinical pharmacy and therapeutics (6th ed.). Churchill Livingstone/Elsevier.
7. DiPiro, J. T., Yee, G. C., Posey, L. M., Haines, S. T., Nolin, T. D., & Ellingrod, V. L. (2023). Pharmacotherapy: A pathophysiologic approach (12th ed.). McGraw Hill.
8. Schwinghammer, T. L., DiPiro, J. T., DiPiro, C. V., & Ellingrod, V. L. (2023). DiPiro's pharmacotherapy handbook (12th ed.). McGraw Hill.
9. Gupta, V., Nguyen, T., Clark, M., Williams, E., Cone, C., & Desselle, S. (2022). Pharmacy practice skills: A guide for students and instructors (2nd ed.). McGraw Hill.
10. Jones, R. M. (2015). Patient assessment in pharmacy practice (3rd ed.). Lippincott Williams & Wilkins.
11. Nemire, R. E. (Ed.). (2023). Pharmacy student survival guide (4th ed.). McGraw Hill.
12. Schwinghammer, T. L., Koehler, J. M., Borchert, J. S., Slain, D., & Park, S. K. (2020). Pharmacotherapy casebook: A patient-focused approach (11th ed.). McGraw Hill.
13. Shargel, L., Mutnick, A. H., Souney, P. F., & Swanson, L. N. (2012). Comprehensive pharmacy review for NAPLEX (9th ed.). Lippincott Williams & Wilkins.
14. Cipolle, R. J., Strand, L. M., & Morley, P. C. (2021). Pharmaceutical care practice: The patient-centered approach to medication management services (3rd ed.). New York, NY: McGraw Hill.
15. Remington, J. P., Troy, D. B., & Beringer, P. (2020). Remington: The science and practice of pharmacy (23rd ed.). Lippincott Williams & Wilkins.

16. Lacy, C. F., Armstrong, L. L., Goldman, M. P., & Lance, L. L. (2024). Drug information handbook (32nd ed.). Lexi-Comp.
17. UpToDate. (Online Database). Clinical decision support for pharmacotherapy. Wolters Kluwer Health. Retrieved 8 April 2025, from https://www.uptodate.com.
18. PharmaGuide Publishing Company. (2025). PharmaGuide. (32nd ed.). Karachi, Pakistan.

PHP-618 | Cr. Hrs. 1

Civics and Community Engagement

Course Learning Outcome

By the end of this course, students will be able to:

1. Describe the principles of civic responsibility and their relevance to the professional practice of pharmacy.
2. Analyze the role of pharmacists in promoting public health, advancing community welfare, and ensuring equitable access to medications and healthcare services.
3. Demonstrate knowledge of the healthcare governance structure in Pakistan and how pharmacists contribute to health policy and regulation.
4. Evaluate pharmacist-led strategies for community engagement, health education, and social responsibility.
5. Apply ethical and inclusive practices in pharmacy services to support civic values such as equity, access, and social justice.
6. Utilize digital platforms responsibly for community health awareness, advocacy, and professional communication.

Contents

1. **Foundations of Civics and Civic Responsibility in Pharmacy**
   - i. Introduction to civics and citizenship within healthcare systems.
   - ii. Professional accountability and ethical conduct as civic duties.
   - iii. The pharmacist as a health advocate and responsible citizen.

2. **Health Governance and the Role of Pharmacists in Society**
   - i. Overview of healthcare governance in Pakistan.
   - ii. Regulatory and professional pharmacy bodies.
   - iii. Pharmacists' role in public health systems, policymaking, and service delivery

3. **Community Health Engagement and Social Outreach**
   - i. Concepts of community development and public health promotion.
   - ii. Models of pharmacist-led interventions.
   - iii. Interprofessional collaboration, working in a multidisciplinary environment, and fostering public trust.

4. **Equity, Inclusion, and Social Justice in Pharmacy Practice**
   - ii. Addressing health disparities: socioeconomic, gender, rural/urban divides, etc.
   - ii. Ensuring equitable and inclusive pharmacy services for all segments of the population.
   - iii. Pharmacist's role in promoting ethical and equitable healthcare.

5. **Advocacy and Public Health Leadership**
   - i. Public health advocacy: promoting responsible and rational use of medicines, preventing the irrational use of antibiotics and other medications, and preventing drug abuse and misuse, along with related initiatives.
   - ii. Strategies for effective communication and civic leadership.
   - iii. Mobilizing community participation in health promotion initiatives.

6. **Digital Citizenship and Professional Ethics**
   - i. Responsible use of digital platforms for health promotion.
   - ii. Cyber ethics and confidentiality in digital health communication.

iii. Bridging the digital divide in pharmacy services and patient education.

Recommended Reading

1. 1. International Pharmaceutical Federation. (2020). *Pharmaceutical practice: Focus on patient care* (2020 ed.). International Pharmaceutical Federation.
2. World Health Organization. (2014). *The role of the pharmacist in the health care system*. World Health Organization.
3. Drug Regulatory Authority of Pakistan. (2012). *Drug Regulatory Authority of Pakistan Act,* 2012. Government of Pakistan.
4. World Health Organization. (2022). *Global strategy on digital health 2020–2025*. World Health Organization.
5. International Pharmaceutical Federation. (2018). *Pharmacists as integral members of the health care team.* International Pharmaceutical Federation.

PHP- 620 | Cr. Hrs. 1

Civics and Community Engagement (Lab)

Course Learning Outcome

By the end of this course, students will be able to:

1. Demonstrate ethical decision-making and professional accountability in simulated and real-world community pharmacy scenarios by applying the Pakistan Pharmacy Council's Code of Ethics.
2. Analyze civic duties and healthcare citizenship principles through case re-enactments to balance patient access, personal ethics, and professional responsibilities.
3. Design and implement pharmacist-led community outreach programs using public health models to address priority health needs and promote community engagement.
4. Evaluate issues of equity and social justice in pharmacy practice by debating resource allocation challenges using population health data from Pakistan.
5. Demonstrate inclusive pharmacy practices by addressing the needs of underprivileged populations through dispensing, counseling, and community service activities.
6. Apply professional competencies, communication skills, and ethical standards during supervised community pharmacy training of at least 100 hours.

Contents

Practical approach and field work in a community pharmacy setup.

1. Students participate in a 90-minute simulation addressing ethical scenarios in pharmacy practice (e.g., a patient requesting unprescribed antibiotics in a Pakistani community pharmacy). In groups, students discuss professional accountability, referencing the Pakistan Pharmacy Council's Code of Ethics, and present a decision-making framework. Faculty evaluate based on ethical reasoning and civic responsibility. (1-2 hours) (Model Pharmacy
2. Students analyze real-world cases in a re-enactment. Using a worksheet, they outline civic duties (e.g., patient access vs. personal ethics) and propose solutions aligned with healthcare citizenship principles. Groups present findings, fostering discussion on balancing personal and professional roles. (1 hour)
3. In groups, students design a pharmacist-led outreach program for a Pakistani community (e.g., diabetes awareness in a rural area). They create posters and scripts, incorporating models like the Health Belief Model, and role-play delivering the campaign to peers acting as community members. Evaluate on engagement and public health impact. Visit a remote area, gifting to the geriatrics or mothers etc.
4. Debate a topic like "Should pharmacists prioritize urban vs. rural patients for vaccine distribution?" Each group uses data from Pakistan's Demographic and Health Survey to argue for equitable access, incorporating ethical principles.
5. Inclusivity (dispensing for un-privileged and under privileged population of Karachi).
6. Training in a community pharmacy for at least 100 hours.

Recommended Reading

1. Pakistan Pharmacy Council. (2017). Code of ethics for pharmacists. Pakistan Pharmacy Council.
2. World Health Organization. (2014). The role of the pharmacist in the health care system. World Health Organization.
3. World Health Organization. (2021). WHO guideline on ethical issues in public health surveillance. World Health Organization.
4. National Institute of Population Studies (NIPS) [Pakistan], & ICF. (2019). Pakistan demographic and health survey 2017–18. NIPS and ICF.
5. International Pharmaceutical Federation. (2018). Pharmacists as integral members of the health care team. International Pharmaceutical Federation.

PHP-622 | Cr. Hrs. 3

Pharmacy Practice Experience (Clinical Clerkship)

Training Learning Outcomes

By the end of this PPE student should be able to:

1.1. Participate as an inter-professional team member:
Interact appropriately with other members of the healthcare team. The student must demonstrate the ability to deliver patient-centered care as a member of an Inter- Professional team, emphasizing evidence-based practice, quality improvement approaches, and informatics. The student must also be able to assess how well the group functions as a team.

In case of Hospital & clinical settings internship following components may be performed.

1.2. Perform Patient Assessments
The student must demonstrate the ability to collect patient data (e.g., a medication history, the medical chart, and/or laboratory data) and assess a patient's health status. The goal of performing this patient assessment is to prevent, identify, and solve medication-related problems.

1.3. Conduct Drug Therapy Reviews
The student must demonstrate the ability to successfully review a medication profile or medication administration record and identify medication-related problems.

1.4. Demonstrate Written/Verbal Communication
The student must demonstrate the ability to communicate a variety of pharmacotherapy topics and issues. Furthermore, the student must demonstrate the ability to perform this competence both verbally and in writing. Students are also expected to demonstrate the ability to verbally present pharmacotherapy content/topics and discuss the topic with the audience.

1.5. Perform Pharmacokinetic Monitoring
The student must demonstrate the ability to apply pharmacokinetic concepts in establishing a therapeutic regimen when a patient is receiving a drug that has a narrow therapeutic range. Specifically, the student must demonstrate the ability to design a dosage regimen based on population pharmacokinetic parameters and when serum drug levels are available, assess whether the current regimen is providing the desired effect.

1.6. Use Systems Management to Improve Therapeutic Outcomes
The student must demonstrate the ability to manage a medication distribution system and informatics so that therapeutic outcomes are optimized. For example, the student must demonstrate the ability to resolve potential and actual medication errors and develop strategies for preventing future occurrences.

Contents

Students can start PPE in third year. The PPE shall be graded by faculty members in fifth year.

The clinical pharmacy field experience is an integral part of the Pharm. D program which is meant to offer an opportunity for the students to have hands-on practice of what they learn in the classroom. The students under the supervision of various departments and preceptors will integrate their knowledge of physical assessment, pharmacology, pharmaceutics, communication skills, pharmacokinetics, pharmacodynamics, and management guidelines of various diseases in assessing therapeutic plans and evaluating the selected drugs for patients. PPE can be performed in Community Pharmacy, Pharmaceutical Industry, Regulatory and Sales & Marketing, including Hospital & clinical settings.

S. NO.	Learning Domains	Method
1.0	**Knowledge**	
1.1	Describe the symptomatology, physical findings, pathophysiology, diagnostic procedures, laboratory tests, concentrated electrolytes, therapeutic duplication primary and alternative pharmacotherapies, and non-pharmacological treatments for all the encountered infectious diseases.	Clinical Rounds
2.0	**Cognitive Skills**	
2.1	Perform and practice: Clinical skills including collecting and recording patient-specific data, measuring and documenting patient outcomes, problem-solving, medication monitoring, dosing, therapeutic recommendations, medication reconciliation, patient education and discharge counseling, medication error reporting, and responding to drug information queries with effective communication skills (verbal & written).	Clinical Rounds
2.2	Gather and relate to the patient's clinical and diagnostic data, pathophysiology, differential diagnosis, pharmacokinetic monitoring, pharmacologic, therapeutic, Pharmacoeconomics, and surgical interventions employed in those patients with cardiac disease.	Clinical Rounds
3.0	**Interpersonal Skills & Responsibility**	
3.1	PDemonstrate the ability to interact with patients or patient care givers in a manner consistent with the patient's age, level of understanding, physical disability, or other barriers common to the critical care environment.	Clinical Rounds
4.0	**Communication, Information Technology, Numerical**	
4.1 (a)	Communicate to both patients and healthcare Prescribers	Clinical Rounds
4.1 (b)	Interview patients and take medication history	Clinical Rounds
4.2	Effectively communicate therapeutic interventions to other members of the health-care team.	Clinical Rounds
4.3	Assess patient medications and provide medication reconciliation for diabetic, asthmatic and hypertensive Patients	Clinical Rounds
5.0	**Psychomotor**	
5.1	Medication appropriateness review.	Clinical Rounds
5.2	Identify and prevent all clinically significant drug Interactions	Clinical Rounds
5.4	Participate in ambulatory clinics. Provide drug information and pharmaceutical services to medical Clinic staff and patients.	Clinical Rounds
5.5	Develop Pharmaceutical care plans	Clinical Rounds

5.6	Antimicrobial Stewardship and oncology stewardship, Narcotic stewardship	
5.7	Drug utilization review	Clinical Rounds
5.8	Assessment and management of adverse drug reactions (ADRs)	Clinical Rounds
5.9	Medicine Reconciliation	Clinical Rounds

PHP-710 | Cr. Hrs. 3

Advanced Clinical Pharmacy II

Course Learning Outcome

At the completion of this course students will be able to

1. To systematically identify individual patient needs and apply this understanding to develop and optimize pharmacotherapy plans that align with those needs. This includes considering patient-specific factors and ensuring the pharmacotherapy regimen is tailored for maximum benefit.
2. To integrate knowledge of disease pathophysiology and etiology with current evidence-based practices to formulate effective pharmacotherapy and comprehensive pharmaceutical care plans. This encompasses making informed clinical decisions grounded in scientific literature and best practice guidelines.
3. To perform thorough medication reconciliation to ensure medication safety and identify patient-specific risk factors that may impede optimal treatment outcomes. This includes the ability to analyze medication histories and recognize potential barriers to successful therapy.
4. To effectively educate and counsel patients on various aspects of their disease management and medications. This includes communicating complex information in an understandable manner, addressing patient concerns, and empowering patients to actively participate in their care.

Contents

1. Selection and Dosing of IV fluid therapy, Incompatibilities and monitoring parameters
2. Management of common infectious disease specific to Pakistani setting i.e. Malaria, Dengue, Sepsis, Tuberculosis, Sinusitis, Laryngitis, Pharyngitis, Pneumonia
3. Oncology: Breast cancer, Prostate Cancer, Benign Prostate Hyperplasia
4. Renal and Hepatic Failure and its management along with the pharmacotherapy of other comorbid conditions
5. Urology: Nephrotic syndrome, Urinary tract infection, Prostatitis, Chlamydia, Syphilis, Gonorrhea
6. Common Coagulation and bleeding disorders over the counter and in hospital setting eg. Deep vein thrombosis, Thrombocytopenia and Pulmonary Embolism. With specific focus on the use of warfarin, heparin, aspirin and non-vitamin K antagonist
7. Management of Hematological disorders i.e. Anemia, Thalassemia
8. Management of Asthma and COPD
9. Management of Patients and pharmacotherapy optimization in emergency situations, poisoning and patient drug need relevant to the administration of the antidotes.

Recommended Reading

1. DiPiro, J. T., Talbert, R. L., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (11 Eds.). (2022). Pharmacotherapy: a pathophysiological approach.
2. Koda-Kimble, M.A. ed., 2007. Handbook of applied therapeutics. Lippincott Williams & Wilkins.
3. DiPiro's Pharmacotherapy Handbook, 12th Edition
4. Chisholm-Burns, Marie A., Terry L. Schwinghammer, Patrick M. Malone, Jill M. Kolesar, Kelly C. Lee, and P. Brandon Bookstaver. Pharmacotherapy principles and practice. McGraw-Hill, 2022.

PHP-712 | Cr. Hrs. 1

Advanced Clinical Pharmacy II (Lab)

Course Learning Outcome

At the completion of this course students will be able to

1. Prepare comprehensive SOAP notes and pharmaceutical care plans for simulated or real patient cases related to the diseases covered in this unit.
2. Provide effective patient counselling and education to achieve optimum therapeutic goals and improve medication adherence.
3. Recommend appropriate dose adjustments, therapeutic alternatives, and non-pharmacological interventions to enhance clinical outcomes and patient well-being.
4. Interpret laboratory values and identify suitable pharmacotherapeutic interventions in accordance with evidence-based clinical guidelines.
5. Apply principles of therapeutic drug monitoring by analyzing clinical cases to determine appropriate dosing and monitoring parameters for drugs including vancomycin, amikacin, gentamicin, phenytoin, amiodarone, digoxin, and cyclosporin.

Contents

1. Students must be able to prepare SOAP Notes or Pharmaceutical care plan for the disease discussed in this unit. Case studies can be either simulated or real cases depending on availability.
2. Patient counselling and Education to achieve optimum therapeutic goals specific to the diseases covered in this unit.
3. Dose adjustments, Selection of Alternates, Non-Pharmacological measure to improve the therapeutic outcomes and well-being
4. Interpretation of Lab values and identification of suitable interventions as per evidence-based guidelines.
5. Students must practice Therapeutic drug monitoring for the following drug: Vancomycin, Amakacin, Gentamicin, Phenytoin, Amiodarone, Digoxin, Cyclosporin, must practice on cases to learn what dose to administer and what parameters to monitor for effective outcomes.

Recommended Reading

1. DiPiro, J. T., Talbert, R. L., Yee, G. C., Matzke, G. R., Wells, B. G., & Posey, L. M. (11 Eds.). (2022). Pharmacotherapy: a pathophysiological approach.
2. Koda-Kimble, M.A. ed., 2007. Handbook of applied therapeutics. Lippincott Williams & Wilkins.
3. DiPiro's Pharmacotherapy Handbook, 12th Edition
4. Chisholm-Burns, Marie A., Terry L. Schwinghammer, Patrick M. Malone, Jill M. Kolesar, Kelly C. Lee, and P. Brandon Bookstaver. Pharmacotherapy principles and practice. McGraw-Hill, 2022.

PHP-714 | Cr. Hrs. 3

Pharmaceutical Regulatory Science - II

Course Learning Outcome

After the completion of this course students will be in a position to:

1. Understand the Drug Regulatory Authority of Pakistan (DRAP) and its governing legislation (DRAP Act 2012).
2. Understand the 'why' and 'who' of pharmaceutical regulation, focusing on DRAP's structure and legal basis.
3. Compare international regulatory pathways for biosimilar approvals, identifying key considerations for global market access.

Contents

1. **DRAP Act 2012** –, licensing, registration, pricing, pharmacovigilance, and the PIRMS (Pakistan Integrated Regulatory Management System).

2. **Global & National Regulatory Frameworks**—An overview of SRAs and Regulatory Bodies of neighboring countries, WHO Benchmarking Tools, Introduction to PICs guidelines

3. **Drug Registration & Lifecycle Management** – The curriculum covers ICH CTD/eCTD dossier requirements, clinical/non-clinical data evaluation, and global procedures for product approvals, variations, and post-market changes.

4. **Good Manufacturing Practices (GMP) & Inspections** – Key topics include GMP compliance, regulatory inspections (facility, clinical, lab), and the use of digital tools like PIRMS for audit management and corrective actions.

5. **Pharmacovigilance & Post-Market Surveillance** – The program emphasizes adverse event monitoring, signal detection, and risk management plans (RMPs), highlighting the roles of manufacturers, regulators, and healthcare providers in ensuring drug safety.

6. **Medical Devices & Medicated Cosmetics Regulation** – Students learn about device classification (Class I-IV), registration pathways, re-registration requirements, and the oversight of medicated cosmetics under frameworks like APAC Med and SARC.

7. **Study of related laws in Pakistan** – Pharmacy Act 1967, PPRA Rules, 2004/respective provincial procurement related rules and an overview of CNSA, 1997.

8. Pakistan Health Policy

Recommended Reading

1. Pharmaceutical Regulatory Affairs – Sachin Itkar (adaptable to local laws)
2. DRAP Act 2012 – Official Government of Pakistan publication
3. DRAP Guidelines & Notices (www.drap.gov.pk)
4. WHO Guidelines for Pharmaceutical Regulations
5. Pakistan Drug Rules 1976 and amendments
6. Drug Regulatory Affairs: Principles and Practices Author: Javed Ali, Roop Khar
7. New Drug Development: A Regulatory Overview Author: Mark Mathieu
8. International Conference on Harmonization (ICH) Guidelines
9. Key Guidelines:
   a. ICH E6(R2) Good Clinical Practice (GCP)
   b. ICH M4 — Common Technical Document (CTD) Structure
   c. ICH Q8 — Pharmaceutical Development (Quality by Design)

Group Photo of the Dean Office Staff

Sitting, from L to R: Mr. Muhammad Faizan, Mr. Zahid Ahmed Khan, Mr. Nadeem Ahmed, Mr. Muhammad Faisal Aziz, Mr. Mir Jamali.
Standing, from L to R: Mr. Faizan Khalil, Mr. Waqar Khan.

Group Photo of the Seminar Library Staff

Sitting, from L to R: Mr. Rafiat Wasiullah, Ms. Tasneem Ara Khanum, Mr. Muhammad Nadeem.

Group Photo of the Non-Teaching Staff
Department of Pharmaceutics

Sitting, from L to R: Mr. Furqan Aleem, Mr. Muhammad Kabir, Mr. Muhammad Naeem Khan, Mr. Muhammad Shahid, Baloch, Mr. Faheem Ahmed.
Standing, from L to R: Mr. Kamran Khan, Mr. Shafiq Iqbal Khan, Mr. Atif Hussain, Mr. Moon, Mr. Muhammad Danish Khatak, Mr. Sanaullah Khan.

Group Photo of the Non-Teaching Staff
Department of Pharmaceutical Chemistry

Sitting, from L to R: Mr. Naeem Ahmed, Mr. Muhammad Rashid, Mr. Muhammad Khalid Khan, Mr. Shoaib Khan, Mr. Abdul Waheed.
Standing, from L to R: Mr. Muhammad Hamza Siddiqui, Mr. Manzooruddin, Mr. Amir Khan.

Group Photo of the Non-Teaching Staff
Department of Pharmacology

Sitting, from L to R: Mr. Fareed Ur Rehman, Mr. Syed Faisal Ul Haq, Mr. Muhammad Ibrahim, Mr. Inayat Ali, Mr. Ghulam Sarwar.
Standing, from L to R: Mr. Muhammad Aamir, Mr. Ajaz Ahmed Qureshi.

Group Photo of the Non-Teaching Staff
Department of Pharmacognosy

Sitting, from L to R: Mr. Khawja Azhar, Mr. Muhammad Mansoor, Ms. Uzma Parveen, Mr. Muhammad Rehan, Mr. Muhammad Shahab Ali.

Important Rules to Remember

1. Rules Concerning the Promotion and Repetition of Courses

The student passing at least 80% courses in an academic year would be promoted to next higher class. There would be no special examination for courses of Pharm. D. first to fifth professional class. Students requiring to pass such a course, shall repeat it along with the regular class. There may be a supplementary examination for the failures of the Pharm. D. fifth Professional. This examination will be held after six weeks of the announcement of the Pharm. D. (Final) results.

2. Attendance

Attendance in each subject is compulsory for all students and no student shall be eligible to appear at any University examination unless he has attended 75 per cent classes in the course.

Shortage in attendance up to 5 per cent only may be condoned by the Dean for bonafide reasons. The Vice-Chancellor may condone a further shortage of 10 per cent in cases of special hardship, but no student whose attendance falls below 60 per cent shall be sent up for any University examination.

Attendance will be counted from the date classes begin and NOT from the date of admission of a student. Provided that the attendance of a student admitted after rendering National Service will be counted from the date of his admission.

A student who shows indifference to his studies by continued absence for 3 weeks from the date of his admission shall cease to be a student of the University. Appeal against the cancellation of admission may be made to the Chairman of the Department and the Dean's decision in this behalf shall be final.

3. Maximum Duration for Completion of Degree

Maximum duration for completion of Pharm.D. degree will be seven years. After this period fresh admission at the level of Pharm.D. 1st Year will be required.

Guidelines to Participate in Convocation

These are some notes which will help to understand the ethics for participation in Convocation, a memorable moment in life:

- Do not forget to bring your Invitation Card with you, because entry will not be allowed without Invitation Card.
- Participating graduates may be accompanied by his/her parent/guardian as specified by them during registration.
- Degree participants should reach the convocation ground on time.
- Wear the special dress, including the gown, hood and the special cap.
- The hood color represents your faculty, and for Pharmacy, the color is gray.
- Before the endorsement of degree, the tassel of the cap is on your right side.
- After the degree is conferred, bow down your head, and change the direction of the tassel to your left this is called turning of tassel indicating that now you are a graduate.
- Leave the ground quickly and at the end of the ceremony after all the degrees are conferred, throw your cap in air to show your happiness and joy.

Academic Calendar (Morning Program)

First Semester 2026

Orientation Day	January 01, 2026
Teaching	January 02 – May 02, 2026
Semester Examinations	May 05– May 25, 2026
Semester Break	June 01– June 26, 2026

Second Semester 2026

Teaching	June 29 – October 30, 2026
Semester Examinations	November 04 –November 30, 2026
Semester Break	December 01 – December 31, 2026

Academic Calendar (Evening Program)

First Semester 2026

Orientation Day	January 12, 2026
Teaching	January 13- February 16, 2026
Ramadan	Online class schedule February 17, 2026– March 19, 2026 (Tentative dates depending on the Ramadan moon sighting)
Eid ul Fitr Break	March 20 – March 24, 2026
Teaching Resume	March 25 – May 12, 2026
Semester Examinations	May 18, – June 19, 2026
Semester Break	June 20, –July 19, 2026

Second Semester 2026

Teaching	July 20 – November 20, 2026
Semester Examinations	November 23 – December 24, 2026
Semester Break	December 25, 2026 Till the commencement of the First Semester-2027

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Pharmacy and Pharmaceutical Sciences

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