

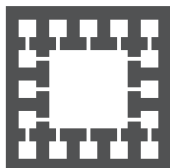


Department of Pharmacy School of Science and Technology

B.PHARM (Honours) OBE CURRICULUM

(Effective from Spring 2026)

VARENDRA UNIVERSITY



বরেন্দ্র
বিশ্ববিদ্যালয়

Varendra University

CONTENTS

Part A – Introduction

	Title and subtitle	Pages
1.	Title of the Academic Program	15
2.	Vision of the University	15
3.	Mission of the University	15
4.	Name of the Degree	15
5.	Name of the Faculty Offering the Program	15
6.	Name of the Department Offering the Program	15
7.	Vision of the Program	15
8.	Mission of the Program	15
9.	Description of the Program	16
10.	Program Educational Objectives (PEO)	16
11.	Program Learning Outcomes (PLO)	16
12.	Graduate Attributes (GA)	17
13.	Mapping /Alignment Program Mission vs PEO	18
14.	Mapping /Alignment PEO vs PLO	18
15.	Mapping /Alignment PLO vs GA	18

Part B – Curriculum Structure

	Title and subtitle	Pages
16.	Curriculum Structure	19 - 23

Part C – Description of All Courses

	Title and subtitle	Pages
17.	Description of All Courses	24 - 210

CONTENTS

Part D – Assessment & Evaluation

	Title and subtitle	Pages
18.	Admission	211
19.	Admission Requirement	211
20.	Academic Standards	211
21.	Award of Degree	212
22.	Examinations	212
23.	Grading System	212
24.	Calculation of Grade Point Average (Gpa)	213
25.	Required Class Attendance For Examination	214
26.	Promotion	214
27.	Improvement	215
28.	Retake	215
29.	Re-admission	216
30.	Semester Drop & Cancellation of Admission	216
31.	Academic Dismissal From The Program	217

Appendix

	Title and subtitle	Pages
32.	Co-curricular Activities	217
	A) Pharma Bee Club	217
	B) Other Co-curricular Activities	218
33.	Alumni Association	218
34.	Library Rules and Regulations	219
35.	Student Code of Conduct	220
36.	Examination Code of Conduct	221





**Message from the
HONORABLE CHAIRMAN**

It gives me immense pleasure to extend my warmest greetings to all of you in the Department of Pharmacy. As the Chairman of the Trust, I take great pride in witnessing the growth and achievements of this dynamic department, which continues to uphold our shared vision of academic excellence, innovation, and service to humanity.

Pharmacy is not merely a profession it is a commitment to improving lives, promoting health, and serving society with integrity and compassion. As future pharmacists, researchers, and healthcare professionals, you are stepping into a field that is both challenging and rewarding. Your role in ensuring safe, effective, and accessible healthcare will be more vital than ever in the years to come.

I encourage each of you to make the most of the opportunities available-engage actively in your studies, participate in research, attend seminars, and remain curious at all times. Remember that true learning goes beyond textbooks; it involves critical thinking, ethical practice, and a deep sense of responsibility toward the well-being of others.

Our Trust remains committed to supporting the Department of Pharmacy with the necessary resources, infrastructure, and guidance to help you excel academically and professionally. We believe in your potential and are confident that you will make us proud by contributing meaningfully to the pharmaceutical and healthcare sectors.

A handwritten signature in black ink, appearing to read 'Hafizur Rahman Khan'. The signature is fluid and stylized, with a prominent loop at the end.

Hafizur Rahman Khan

Chairman

Varendra University Trust

**Message from the
VICE CHANCELLOR**



It gives me great pleasure to address you, the bright and aspiring minds of the Department of Pharmacy. As future healthcare professionals, you occupy a vital place in society's well-being and advancement. Pharmacy is not just a profession; it is a commitment to improving human life through knowledge, research, and ethical practice. I am proud to see that you are part of a department that consistently upholds academic excellence, innovation, and integrity. I urge you to make the most of the learning opportunities provided to you, both inside and outside the classroom. Engage actively with your faculty, participate in research and community service, and stay curious and committed to lifelong learning. Remember, the knowledge and skills you acquire here will have a direct impact on the health and lives of countless individuals in the future.

As part of our ongoing efforts to enhance the quality and relevance of education at our institution, I would like to emphasize the importance of implementing the Outcome-Based Education (OBE) framework across all academic programs, with particular focus on the curriculum of the Department of Pharmacy. The OBE approach of the Department of Pharmacy, which focuses on achieving specific learning outcomes, has proven to be an effective means of aligning educational practices with industry needs and global standards. It ensures that students acquire not only theoretical knowledge but also practical skills. As we move toward more student-centered and outcome-based education, I encourage you to take ownership of your academic journey. Embrace challenges, seek clarity, and always strive for excellence. Your dedication today will shape the pharmacy profession of tomorrow. The university is proud of you, and we are here to support your growth every step of the way. I wish you all continued success in your studies and future endeavors.

A handwritten signature in dark ink, appearing to read 'MIM', with a stylized flourish extending to the right.

Prof. Dr. Md. Khademul Islam Molla
Vice Chancellor
Varendra University



Message from the
HEAD OF THE DEPARTMENT

It is with great pleasure that I welcome you all to another promising academic journey. Whether you are just beginning your undergraduate studies or continuing your pursuit of knowledge and excellence, know that you are an integral part of our department. The Department of Pharmacy is dedicated to excellence in pharmaceutical education, research, and community service. Since its establishment, the department has played a pivotal role in producing skilled, ethical, and competent pharmacy professionals who contribute to the healthcare sector both nationally and globally. Our mission is to provide a comprehensive understanding of pharmaceutical sciences, encompassing drug discovery, development, manufacturing, and clinical application. The curriculum is designed to meet international standards, combining theoretical knowledge with practical laboratory experience and industry exposure. We are committed to fostering a research-oriented environment. Students and faculty actively engage in research projects addressing contemporary health challenges, with several publications in national and international journals. Facilities in the department include well-equipped laboratories and industry-standard instruments. We also maintain strong collaboration with pharmaceutical industries to ensure our students are well-prepared for professional careers and higher studies. I encourage each of you to make the most of your time here - engage actively in your classes, participate in research and co-curricular activities, and never hesitate to seek guidance from your teachers. Your curiosity, discipline, and dedication will shape your future and contribute to the betterment of society. Let us continue working together to uphold the reputation and standards of the Department of Pharmacy. I wish you all the very best in your academic and personal endeavors.

Prof. Dr. Md. Bytul Mokaddesur Rahman

Head

Department of Pharmacy

Varendra University

Members of the Curriculum Committee

No.	Name / Designation	Affiliation	Role
1.	Head, Department of Pharmacy	Varendra University	Chairperson
2.	All Faculty Members, Department of Pharmacy	Varendra University	Member
3.	Chairman, Department of Pharmacy	University of Rajshahi	Member
4.	Prof. Dr. Md. Golam Sadik, Department of Pharmacy	University of Rajshahi	Member
5.	Dr. Md. Mustafizur Rahman, Pharmacy Discipline	Khulna University	Member
6.	Md. Abrar Elahi Khan, Sr. Manager, R & D	Beacon Pharma (Employer Representative)	Member
7.	Md. Sajedul Islam, Senior Executive	Team Pharmaceuticals Ltd. (Alumnus)	Member

Faculties



Prof. Dr. Md. Bytul Mokaddesur Rahman

Head, Department of Pharmacy
Dean, School of Science and Technology, VU
D.Sc. in Structural Biology (Nagoya University, Japan)
M.Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



Dr. Tripti Rani Paul

Associate Professor
Ph. D. in Pharmacology (RU)
M. Pharm (Thesis)- University of Rajshahi (RU)
B. Pharm (Hons.)- University of Rajshahi (RU)



Dr. Mst. Hajera Khatun

Associate Professor
Ph.D. in Virology (Yokohama City University, Japan)
M. Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



Dr. Khadiza Khanam

Associate Professor
Ph.D. in Pharmacology (IBSc, RU)
M.Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



Dr. Nurunnahar

Associate Professor
Ph.D. in Pharmacy (IBSc, RU)
M. Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



Md. Mahbubur Rahman

Assistant Professor (On Study Leave)
M.Pharm(Thesis)- University of Rajshahi (RU)
B.Pharm(Hons.)- University of Rajshahi (RU)

Faculties



Dr. Simin Shabnam Lopa

Assistant Professor
Ph.D. in Pharmacy (IBSc, RU)
M.Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm(Hons.)- University of Rajshahi (RU)



Md. Maniruzzaman

Assistant Professor (On Study Leave)
M.Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi(RU)



A.S.M. Sakhawat Hossain

Assistant Professor (On Study Leave)
Ph.D. in Medical Science (University of Tsukuba, Japan)
M.Pharm (Thesis)- University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



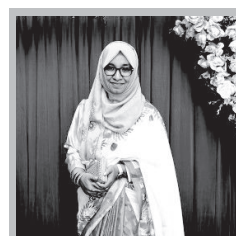
Shammi Akhter

Assistant Professor
M. Phil (RU)
M.Pharm (Thesis) - University of Rajshahi (RU)
B.Pharm (Hons.)- University of Rajshahi (RU)



Nuzhat Tasnim Amin

Lecturer (On Study Leave)
M.Pharm (Thesis)- (UAP)
B.Pharm(Hons.)- Varendra University (VU)



Sanzia Mejbabin

Lecturer
M.Pharm (Clinical Pharmacy &
Molecular Pharmacology)- (EWU)
B.Pharm (Hons.)- Varendra University (VU)

Faculties



Md. Mostafizur Rahman

Lecturer

M.Pharm (Pharmaceutical Biochemistry)-
(Dongguk University, South Korea)

B.Pharm (Hons.) - Varendra University (VU)



Abu Naser Md. Nayeem

Lecturer

M.Pharm (Thesis) - University of Rajshahi (RU)

B.Pharm (Hons.) - University of Rajshahi (RU)



Utsa Saha

Lecturer

M.Pharm (Thesis) - University of Rajshahi (RU)

B.Pharm (Hons.) - University of Rajshahi (RU)



Nowreen Arefa

Lecturer

M.Pharm (Thesis) - University of Rajshahi (RU)

B.Pharm (Hons.) - University of Rajshahi (RU)



Abir Hasan

Lecturer

M.Pharm (Thesis) - University of Rajshahi (RU)

B.Pharm (Hons.) - University of Rajshahi (RU)



Md. Arif Hossain

Lecturer

M.Pharm (Thesis) - University of Rajshahi (RU)

B.Pharm(Hons.) - University of Rajshahi (RU)

Brief Introduction of the VU

The idea and spirit of Varendra University is deeply rooted in the Somapura Mahavihara (or the Great Monastery), a renowned intellectual center that functioned until the 12th century. The Mahavihara is located in Naogaon district, the heart of ancient “Varendra,” close to the village of Paharpur. It was one of the leading institutions of higher learning in ancient India. The other institutions include Pushpagiri, Nalanda, and Taxila.

Varendra University began its journey in 2012 with the initiative of the visionary entrepreneur Mr. Hafizur Rahman Khan. It is envisaged to revive the essence of the ancient institution and kindle the spirits of young learners with the same fire that once moved them towards curiosity and learning.

Situated just a few miles away from the mighty river Padma and the spiritual place of Shah Makhdum, Varendra University is the first Government and UGC approved private university in this region. With 11 departments under three faculties, it is functioning as a premier center for quality education as Somapura Mahavihara did centuries ago. Similarly, it is a home to scholars from diverse backgrounds, dedicated to translating the ethos of the Mahavihara into knowledge and skills applicable to real situations and life of the students. Occupying 18 Acre (approximately 7,84,080 sqf) of land at Kharkhari, Paba Upazila, Rajshahi (Adjacent to Rajshahi City) the university currently has 2 buildings: ten story high academic building and 7 story high administrative building with underground parking area. The total area is 84 classrooms. Each classroom sized 840 sqf. All classrooms in the university are equipped with projectors and PC to provide quality education for our students with high-speed broadband internet & Wi-Fi. CCTV camera and generators provide ultimate security, power and reliability. Water filters are available on each floor. The University has large computer lab equipped with latest generation computers. Students can use the computers for their academic studies. Each student, teacher and officer have access to Microsoft Teams office application online, which provides free access to office 365 software and 1 terabyte of cloud storage with an educational E-mail ID. The University has a large library in the university campus having thousands of academic books stored for each department. Students can borrow books for their studies from the library. They also have support from Wiley Online Library which has huge collection of academic books.

The university has almost 229 (Full-Time) faculty members, 40+ (Adjunct faculty members), 87 officers and 51 supporting staffs. The university has 21 well equipped laboratories for science & engineering students. As per the guidelines of UGC and Bangladesh Accreditation Council, from Spring-2023 the university conducting all educational activities in Bi-semester system. Extra-Curricular Activities e.g. Study Tour, Seminars, Debates and Contests, Moot court competitions, Participation in National and International Competitions, Career Center, Parent’s Day, Social Awareness Activities for Deprived People, Observance of National Days and Celebrations, Picnic, Indoor-outdoor Games, Cultural Program is frequent.

Introduction to the Department of Pharmacy



Established in January 2013, the Department of Pharmacy at Varendra University has developed into a dynamic academic unit dedicated to excellence in pharmaceutical education, research, and professional development. The department was established in response to the growing national and global demand for pharmacy graduates in the pharmaceutical industry, healthcare institutions, academic and research organizations, and government health services.

The Department of Pharmacy is approved by the University Grants Commission (UGC) of Bangladesh and accredited by the Pharmacy Council of Bangladesh (PCB). It currently offers the Bachelor of Pharmacy (Honours) degree—a four-year undergraduate program structured over eight semesters, with two academic semesters each year: the Spring Semester and the Summer Semester. The curriculum is contemporary, outcome-based, and aligned with the educational standards of leading universities in Bangladesh and abroad. It is regularly updated to reflect the latest developments in pharmaceutical sciences, public health, and industry needs.

The department is supported by a team of highly qualified and experienced faculty members dedicated to academic excellence and student mentorship. Teaching is enhanced through ICT-enabled classrooms, well-equipped laboratories, and a departmental library with a rich collection of books, journals, and research publications. Students benefit from collaborative research opportunities and strong institutional linkages that foster growth.

Graduates from the department are contributing across diverse roles in healthcare and the pharmaceutical sector. Many are working in top pharmaceutical companies, pursuing postgraduate studies, or contributing to government health services and academia. The department is committed to producing ethically grounded, technically competent, and globally competitive professionals ready for the evolving healthcare landscape.

We invite you to explore our programs, connect with our faculty, and join our mission to advance knowledge and improve lives through pharmaceutical science.

Part A- Introduction

1. Title of the Academic Program

Bachelor of Pharmacy (Honours)

2. Vision of the Varendra University

The vision of Varendra University is to be established as a top-ranking university nationally and internationally through continuous innovation in education, research, creativity, and entrepreneurship.

3. Mission of the Varendra University

1. To prepare students as competent, compassionate, ethically driven, and socially responsive professionals.
2. To educate them through research for intellectual as well as social transformation.
3. To enhance their lifelong learning capacity for adaptability to face the challenges of the 21st century.

4. Name of the Degree

B. Pharm. (Honours).

5. Name of the Faculty Offering the Program

School of Science and Technology.

6. Name of the Department Offering the Program

Department of Pharmacy.

7. Vision of the Program

To be recognized nationally and worldwide for high-quality pharmacy education and research in pharmaceuticals as well as health-related fields.

8. Mission of the Program

M1	To develop, research and translate potential innovations in pharmacy and pharmaceutical sciences into practice in order to produce and spread knowledge.
M2	To ameliorate our caring abilities, compassion, and collaborative culture in order to ensure high-quality education.
M3	To develop moral and ethical leaders in pharmacy with perfect skills to address the medication and health needs of the society.
M4	To prepare the students to meet the local and global challenges in pharmacy practice and pharmaceutical sciences.
M5	To maintain fruitful relationships with our alumni, clinical and educational partners as well as the community.

9. Description of the Program

Pharmacy is the art and science of preparing and dispensing medications. Pharmacy is basically a knowledge-based system which renders a health service by concerning itself with understanding drugs and their effects. It is the profession responsible for the appropriate use of medications, devices and services in order to achieve optimal therapeutic outcomes. The purpose of introducing Bachelor of Pharmacy (Honours) curriculum in Varendra University is to introduce beginner pharmacy students to the technological and scientific principles underlying the preparation of dosage forms and drug delivery systems and to their use in patient care.

10. Program Educational Objectives (PEO)

PEO1	To ensure that students acquire knowledge and competence in pharmacy through a robust core curriculum.
PEO2	To encourage students to develop a life-long commitment to learning.
PEO3	To encourage students' curiosity and inquisitiveness in order to help them develop their research skills in clinical pharmacy or pharmaceutical sciences.
PEO4	To inculcate professional competency to become leaders in practice setup and ability to tackle the future challenges successfully.
PEO5	To promote high quality research in the fields of pharmacy.

11. Program Learning Outcomes (PLO)

PLO1	Knowledge: Develop and integrate knowledge on the basic pharmaceutical sciences and life sciences.
PLO2	Execution: Interpret numerical data and display expertise in computing technology for pharmaceutical sciences as well as formulate solutions on theoretical and practical laboratory context.
PLO3	Development of skills: Develop and demonstrate strong interpersonal communication and management skills as well as the ability to work independently or within multidisciplinary teams.
PLO4	Innovation: Demonstrate inventive thinking and implement knowledge to solve problem in drug discovery, formulation development, quality assurance and commercialization.

PLO5	Ethical practice: Demonstrate professional behavior, display self-awareness, self-improvement and practice the profession in an ethically responsible manner.
PLO6	Professional development and leadership: Determine the need and demonstrate the desire for ongoing professional development through lifelong learning.
PLO7	Communication: Communicate effectively about scientific concepts to specialist or to a lay audience through oral and written presentation.
PLO8	Global perspective: Appreciate the global impact of innovation in communications on pharmacy practice.

12. Graduate Attributes (GA)

GA 1	Intellectual breadth and in-depth subject expertise: Graduates possess in-depth knowledge and comprehension of their field, the capacity to interact with many intellectual traditions, and the practical competence to put their knowledge to use in interdisciplinary or multi-professional settings.
GA 2	Thinking critically, creatively, and solving problems: Graduates can utilize critical, creative, and evidence-based thinking to solve problems effectively and come up with novel solutions for upcoming difficulties.
GA 3	Communication skills and team work: Graduates efficiently communicate concepts and information to a number of audiences for a range of reasons, and they positively and cooperatively contribute to the accomplishment of common objectives.
GA 4	Prudence and preparedness for leadership: Graduates exhibit prudent behavior and have the capacity to hold leadership positions in their chosen occupations or careers and communities.
GA 5	Moral integrity: Graduates are responsible and productive global citizens, with personal ideals and practices that align with pharmaceutical sciences and their social responsibilities.
GA 6	Digital Competencies: Graduates have the necessary skills to live, learn, and work in a digital world.

GA 7	Emotional intelligence and self-awareness: Graduates operate with integrity and accept accountability for their actions. They are self-aware and reflective, resilient, flexible, and able to take and offer constructive criticism.
GA 8	Inquisitiveness toward research: Graduates are capable of learning toward the demands of national and international research in the fields of health sciences and pharmaceuticals.

13. Mapping/Alignment Program Mission vs PEO

Mission Statements	PEO1	PEO2	PEO3	PEO4	PEO5
M1	✓		✓		✓
M2	✓	✓		✓	
M3	✓	✓		✓	✓
M4			✓		✓
M5		✓		✓	

14. Mapping/Alignment PEO vs PLO

Mission Statements	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
M1	✓			✓				✓
M2		✓	✓					✓
M3	✓					✓		
M4		✓	✓		✓	✓	✓	
M5	✓	✓	✓	✓	✓			✓

15. Mapping/Alignment PLO vs GA

PLOs	GA1	GA2	GA3	GA4	GA5	GA6	GA7	GA8
PLO1	✓							
PLO2	✓	✓						
PLO3			✓			✓	✓	
PLO4								✓
PLO5					✓		✓	
PLO6				✓				
PLO7			✓					
PLO8						✓		✓

Part B – Curriculum Structure

The Department of Pharmacy accredited by the Pharmacy Council of Bangladesh (PCB) is currently offering undergraduate B. Pharm. (Honors) degree which is divided into eight (8) semesters (2 semesters/year).

Spring Semester: January to June

Summer Semester: July to December

The detailed academic calendar is available at the following webpage on the university website. <http://vu.edu.bd/academic/academic-calendar>

Duration of each semester is 26 weeks, which may be divided into classes, preparatory leave, midterm, semester final examinations, and scheduled vacation as follows:

Working Weeks Distribution	
Semester Activity	Duration
a) Conducting Classes	15 weeks
b) Preparatory Leave	1.5 weeks
c) Midterm & Semester Final Examinations	05 weeks
d) Result Processing	1.5 weeks
e) Scheduled Vacation	03 weeks
The duration of each semester is 26 weeks	

Courses for the Degree of B. Pharm. (Honours)

1st Year 1st Semester

Course Code	Course Title	Credits
0916-111	Inorganic Pharmaceutical Chemistry	3.00
0916-112	Organic Pharmaceutical Chemistry-I	3.00
0916-113	Physical Pharmacy-I	3.00
0916-114	Pharmacognosy-I	3.00
0231-002	English Fundamental	3.00
0916-115	Inorganic Pharmaceutical Chemistry Lab	1.00
0916-116	Organic Pharmaceutical Chemistry Lab	1.00
0916-117	Physical Pharmacy-I Lab	1.00
0916-118	Pharmacognosy-I Lab	1.00
	Total	19.00

1st Year 2nd Semester

Course Code	Course Title	Credits
0916-121	Organic Pharmaceutical Chemistry –II	3.00
0916-122	Physical Pharmacy-II	3.00
0916-123	Physiology and Anatomy-I	3.00
0916-124	Pharmacognosy-II	3.00
0611-003	Computer Fundamental	2.00
0916-125	Physical Pharmacy-II Lab	1.00
0916-126	Physiology and Anatomy-I Lab	1.00
0916-127	Pharmacognosy-II Lab	1.00
0916-128	Oral Assessment-I	1.00
	Total	18.00

2nd Year 1st Semester

Course Code	Course Title	Credits
0916-211	Pharmaceutical Analysis-I	3.00
0916- 212	Microbiology and Immunology	3.00
0916-213	Physiology and Anatomy-II	3.00
0916-214	Basic Pharmaceutics	3.00
0222-001	History of the Emergence of Bangladesh	2.00
0916-215	Pharmaceutical Analysis-I Lab	1.00
0916-216	Pharmaceutical Microbiology Lab	1.00
0916-217	Physiology and Anatomy-II Lab	1.00
	Total	17.00

2nd Year 2nd Semester

Course Code	Course Title	Credits
0916-221	Pharmaceutical Analysis-II	3.00
0916-222	Medicinal Chemistry-I	3.00
0541-223	Mathematics and Statistics	3.00
0916-224	Pharmacology-I	3.00
0916-225	Clinical Pathology	3.00
0916-226	Pharmaceutical Analysis-II Lab	1.00
0916-227	Medicinal Chemistry-I Lab	1.00
0916-228	Pharmacology-I Lab	1.00
0916-229	Oral Assessment-II	1.00
	Total	19.00

3rd Year 1st Semester

Course Code	Course Title	Credits
0916-311	Pharmaceutical Analysis-III	3.00
0916-312	Medicinal Chemistry-II	3.00
0916-313	Pharmacology-II	3.00
0916-314	Pharmaceutical Technology-I	3.00
0916-315	Pharmaceutical Engineering	3.00
0916-316	Applied Pharmaceutical Microbiology	3.00
0916-317	Medicinal Chemistry-II Lab	1.00
0916-318	Pharmacology-II Lab	1.00
0916-319	Pharmaceutical Technology-I Lab	1.00
	Total	21.00

3rd Year 2nd Semester

Course Code	Course Title	Credits
0916-321	Organic Spectroscopy	3.00
0916-322	Pharmacology-III	3.00
0916-323	Pharmaceutical Technology-II	3.00
0916-324	Bio-pharmaceutics-I	3.00
0916-325	Pharmaceutical Quality Assurance and Validation	3.00
0542-326	Research Methodology	3.00
0916-327	Pharmacology-III Lab	1.00
0916-328	Pharmaceutical Technology-II Lab	1.00
0916-329	Pharmaceutical Quality Assurance and Validation Lab	1.00
0916-330	Oral Assessment-III	1.00
	Total	22.00

4th Year 1st Semester

Course Code	Course Title	Credits
0916-411	Medicinal Chemistry-III	3.00
0916-412	Bio-pharmaceutics-II	3.00
0916-413	Pharmaceutical Regulatory Affairs	3.00
0916-414	Biochemistry and Molecular Biology	3.00
0916-415	Pharmaceutical Marketing	2.00
0916-416	Pharmaceutical Biotechnology	3.00
0916-417	Project Work and Presentation	3.00
0916-418	Bio-pharmaceutics- Lab	1.00
0916-419	Molecular Biology and Biotechnology Lab	1.00
	Total	22.00

4th Year 2nd Semester

Course Code	Course Title	Credits
0916-421	Hospital and Community Pharmacy	3.00
0916-422	Clinical Pharmacy and Disease Management	3.00
0916-423	Pharmaceutical Technology-III	3.00
0916-424	Cosmetology	2.00
0916-425	Pharmaceutical Management	3.00
0917-426	Functional Foods, Nutraceuticals, and Herbal Medicines	3.00
0916-427	Pharmaceutical Technology-III Lab	1.00
0916-428	Cosmetology Lab	1.00
0916-429	Oral Assessment-IV	1.00
0916-430	In-plant Training (Industrial and Hospital/Model Pharmacy)	2.00
	Total	22.00

Only for the students who did not take Mathematics in HSC examination		
Course Code	Course Title	Credits
0541-511	Basic Mathematics	3.00

Total Credits in Eight Semesters (Four Years):

Year	Credits
First Year	37.0
Second Year	36.0
Third Year	43.0
Fourth Year	44.0
Total	160.0

Credit Distribution:**Departmental Core Courses: 144.0 Credits****General Education Courses: 16.0 Credits**

Part C- Description of All Courses

Course Code	0916-111
Course Title	Inorganic Pharmaceutical Chemistry
Year & Semester	1st Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Inorganic Pharmaceutical Chemistry is a branch of pharmaceutical sciences which gives the systemic overview of importance of inorganic agents from a pharmaceutical point of view. This course helps to learn about the physicochemical properties as well as the medicinal values of different inorganic compounds and how these compounds are used in different disease conditions. The purpose of this course is to introduce the pharmacy students to the chronological evaluation of structure of atoms. The primary objective of this course is to introduce the pharmacy students to the properties of different classes of inorganic compounds so that they can use this knowledge in future in various fields such as drug designing, toxicology etc. It will demonstrate the characteristics of some of the elements of periodic table like alkali and alkaline earth metals, inert gases etc. In addition, some other important topics like chemical bonds, radioactive elements and their medical applications will be discussed in this respective course. By studying this course, the students will be able to know environmental pollutants and heavy metal toxicities and pharmaceutical impurities.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Achieve a better understanding about the relevance and significance of inorganic pharmacy to pharmaceutical sciences.
CLO2	Develop an understanding of the range and chemistry of elements in the periodic table in association with the understanding the medicinal and pharmaceutical importance of inorganic compounds and radioelements.
CLO3	Evaluate the theory of various bond formations and their association with drug effects and structure modifications etc. Also develop the concept of oxidation-reduction reaction's involvement in drug stability, safety and efficacy and analyze the sources, properties, effects and controlling processes of various pollutants and toxic metal.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				
CLO2	✓	✓						✓
CLO3	✓	✓		✓	✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Structure of Atoms: Elementary treatment of theories of atomic structure, quantum numbers, origin of spectral lines, Pauli's exclusion principle, shapes of s, p, d, f orbitals.	4.5 hrs	CLO1 CLO2
2.	Classification of Elements: Modern periodic table and periodic law, variation of properties within periods and groups, usefulness, and limitation of periodic table.	4.5 hrs	CLO2
3.	Chemical Bonds: Electronic concept of valency, different types of chemical bonds, e.g., ionic, covalent, co-ordinate covalent, metallic, hydrophobic, hydrogen etc. Vander Waal's force, concept of atomic orbital, theories of covalent bonding, resonance, and hybridization. Theories and hybridization approach of coordination compounds.	12 hrs	CLO1 CLO3
4.	Radioactive Elements: Radioactivity, types of radiation, storage of radioactive products. Chemistry, properties, uses of some radioactive compounds used in Pharmacy.	4.5 hrs	CLO2
5.	Oxidation Reduction Reactions: Definition, oxidation number, equivalent weight of oxidants and reductant, decomposition of drugs by redox reaction, ion electron method of balancing equation, importance, and determination of redox potential.	10.5 hrs	CLO1 CLO3
6.	Environmental Chemistry: a) Environmental pollutants: Gases (SO ₂ , SO ₃ , CO, NO, HCl, NO ₂ etc.), hydrocarbons, cigarettes, smokes, suspended particulate, pesticides, gasoline and industrial waste, the detrimental effects of pollutants. b) Heavy metal toxicity: Mercury, arsenic, lead, iron and copper poisoning - prevention and treatment.	6 hrs	CLO1 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)					
				Bloom's Category	Remember	Understand	Apply	Analyze	Create
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture		10-20%	10-20%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%							
	Assignment/ Presentation	5%							
	Midterm Exam	30%							
	Final Exam	50%							
	Total	100%							

Learning References:

1. Modern Inorganic Chemistry- S. Z. Haider
2. Concise Inorganic Chemistry- JD Lee
3. Textbook of Inorganic Pharmaceutical Chemistry- Rogers
4. Inorganic, Medicinal and Pharmaceutical Chemistry- Block and Wilson
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Modern Inorganic Chemistry – RD Madan.
7. Modern Inorganic Pharmaceutical Chemistry- Discher

Course Code	0916-112
Course Title	Organic Pharmaceutical Chemistry-I
Year & Semester	1st Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Organic Pharmaceutical Chemistry is essential for pharmaceutical sector. The course is designed to study the basic concepts of organic compound. By this course the students will learn about IUPAC nomenclature of organic compounds, their methods of preparation, physicochemical properties and pharmaceutical applications.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the basic concept of organic compounds.
CLO2	Identify electrophile, nucleophile, carbonium ion, carbanion, acid, and base.
CLO3	Analyze and draw structures of the different organic molecules.
CLO4	Create a good idea about reaction mechanism, IUPAC nomenclature of organic compounds and their application.
CLO5	Create a good idea about the reaction mechanism, IUPAC nomenclature of organic compounds and their application.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				
CLO3	✓			✓				
CLO4	✓							
CLO5	✓							✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	General Introduction: Historical background of organic chemistry, basic concepts on polarity (polar and non-polar solutes), ionization, carbonium ions, carbanion, hydride, protons, free-radicals, hydrogen bonding, electrophile, nucleophile, acids, bases, etc.	6 hrs	CLO1 CLO2
2.	Chemistry of Aliphatic Compounds: Introduction, nomenclature, methods of preparation, physical and chemical properties and pharmaceutical applications of hydrocarbons (alkane, alkene and alkyne), alcohols, aldehydes, ketones, ester, ethers, amines, amides and carboxylic acids.	18 hrs	CLO1 CLO3 CLO5
3.	Chemistry of Aromatic Compounds: a) Aromaticity, resonanace and orientation b) Preparations, properties, reactions and pharmaceutical importances of phenols, sulfonic acid, carboxylic acid, benzylaldehyde and diazonium compounds.	6 hrs	CLO1 CLO3 CLO5
4.	Heterocyclic compound: Aromaticity, general methods of preparation and properties of furan, thiophene, pyrrole, quinoline, isoquinoline, pyridine, thiozole, imidazole, pyrimidine, indole and their pharmaceutical importance.	12 hrs	CLO1 CLO3 CLO4 CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Introduction to Organic Chemistry- Bahl and Bahl
3. Organic Chemistry- Morrison and Boyd
4. Organic Chemistry (Vol I and II)-Finar
5. Fieser's Reagents for Organic Synthesis –Feiser
6. Advanced Organic Chemistry-Arun Bhal & B.S Bhal.

Course Code	0916-113
Course Title	Physical Pharmacy-I
Year & Semester	1st Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Physical Pharmacy is a physical science that uses the concepts of physics and pharmaceutical chemistry for the study of biological systems. The goal of the physical chemist is to provide physical explanations for the ways in which important biological systems function. Students taking this course are expected to have at least some basic knowledge on fundamental pharmaceutical chemistry. Physical Pharmacy is a highly interdisciplinary field between biochemistry, physical chemistry, biophysics and physics and examines biological process in vitro and in vivo.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Recognize the physicochemical properties of drugs including solubility, distribution, adsorption, and stability.
CLO2	Demonstrate basic rules and equations regarding physical principles essential for pharmaceutical applications.
CLO3	Evaluate the fundamentals of physical chemistry.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓					✓
CLO2	✓			✓				✓
CLO3	✓						✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Properties of matters: a) Gases state: Properties of gases, gas laws, diffusion of gases, kinetic theory of gases, Vander Waal's equation, principle of corresponding states, liquefaction of gases, uses of liquefied gas. b) Liquid state: i) Vaporization and vapor pressure, measurement of vapor pressure. ii) Surface tension, Clausius-Clapeyron equation, measurement, application in pharmacy. iii) Viscosity, Poiseuillies's equation and measurement of viscosity. iv) Application in pharmacy. c) The solid state: General properties of solids, types of solid, symmetry, types of crystal, X-ray diffraction, melting point, polymorphism and dilatometric analysis of compounds. Bragg's equation, measurement of diffraction angle, isomorphism, crystal defects, liquid crystal.	12 hrs	CLO2 CLO3
2.	Solutions: Types and properties of solution, units of concentration, ideal and real solutions, Henry's law and distribution law, colligative properties of dilute solutions, partial coefficient.	6 hrs	CLO1
3.	a) Ionic equilibrium: Proton theory of acids and bases, ionization of water, pH, determination of pH, titration curves of weak acids and bases, ionic strength. b) Chemical equilibrium: Law of mass action, criteria of chemical equilibrium, determination of equilibrium constant, application of law of mass action to homogeneous and heterogeneous equilibrium, Le-Chatelier principle and its application.	12 hrs	CLO2
4.	a) Thermodynamics: First law of thermodynamics, work, energy and heat, heat change at constant volume and constant pressure, reversible, irreversible, isothermal and adiabatic and spontaneous changes, enthalpy and heat content, Gibb's free energy change. b) Thermochemistry: Heat of reaction and Hess's law of constant heat summation.	12 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Principle of Physical Chemistry- Haque and Nawab
2. Physical Chemistry- P. W. Atkins
3. Martin's Physical Pharmacy- A. Martin and J. Swarbrick
4. Essential of Physical Chemistry- Bahl and Tuli.

Course Code	0916-114
Course Title	Pharmacognosy-I
Year & Semester	1st Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The study of drugs and medicines produced from natural sources like plants and animals is known as pharmacognosy. The course 'Pharmacognosy-I' is designed to provide the student with the basic information about pharmacognosy and phytochemistry. The course also describes historical background, scopes and various terminologies used in pharmacognosy.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Outline the basic concept of Pharmacognosy and natural products.
CLO2	Identify drugs from natural origin and their supply, cultivation, collection, storage along with their special conditions.
CLO3	Interpret natural products such as carbohydrates, lipids, gums, mucilage and vitamin containing drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				✓
CLO3	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	General introduction: (i) Definition, scope, historical background of pharmacognosy and its relation to other disciplines of pharmacy. (ii) History, scope and evolution of Pharmacy, different systems of medicine and the code of ethics of pharmacists.	6 hrs	CLO1 CLO2
2.	Drug literatures and publications: Pharmacopoeia, formulary, pharmaceutical codex, index, official, unofficial, non-official and INN drugs (new drugs).	1.5 hrs	CLO1
3.	Crude drugs: A general view of their origin, distribution, cultivation, collection, drying, storage commerce and quality control, classification of crude drugs, evaluation of crude drugs and drug adulteration.	6 hrs	CLO1 CLO2
4.	Phytochemistry: Extraction, separation (chromatographic techniques) and types of plant constituents, primary and secondary metabolites.	6 hrs	CLO1 CLO2

5.	Lipids: Definition, classification, biosynthesis, and physicochemical properties of lipids (Fats, oils and waxes), brief studies emphasizing on sources, chemical constituents and pharmaceutical uses of castor oil, linseed oil, olive oil, peanut oil, chaulmoogra oil and beeswax.	9 hrs	CLO1 CLO3
6.	Vitamins containing drugs: General introduction, cod liver oil, shark liver oil and hilsa fish liver oil.	3 hrs	CLO1 CLO3
7.	Carbohydrate and related compounds: Definition, classification, properties, chemical tests and biosynthesis. a. Monosaccharides and oligosaccharides: Glucose, fructose, sucrose, dextrose etc. b. Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose etc. c. Gums and mucilage's: Tragacanth, acacia, sodium alginate, agar etc.	9 hrs	CLO1 CLO3
8.	Surgical dressing and fibers: Classification, importance, and brief study of different types of surgical dressings and fibers.	1.5 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Pharmacognosy- Tyler and Brady
2. Pharmacognosy- E. P. Claus and V.E. Tyler
3. Trease and Evan's Pharmacognosy - W.C. Evans
4. Textbook of Pharmacognosy - Mohammad Ali
5. Introduction to Pharmacy- Dr. Md. Shah Amran

Course Code	0231-002
Course Title	English Fundamental
Year & Semester	1st Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

English is an international language of communication. The purpose of this course is to improve the English-language proficiency of pharmacy students and to help them to become confident in reading, writing, speaking, and listening to the English language. With a focus on scientific literature, the course draws specific attention for the appropriate use of structures, improvement of practical skills, and the development of scientific writings and presentation.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate proficiency in correct English structures in descriptive, narrative, and instructional texts for easy understanding of pharmaceutical courses.
CLO2	Demonstrate their listening and reading skills in English to communicate confidently, effectively and independently in formal and informal situations.
CLO3	Apply the knowledge of theories, methodologies, and ideologies of English language for scientific writings and presentations.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓					✓
CLO2	✓		✓				✓	✓
CLO3	✓		✓			✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Grammar: Noun and pronoun, adjective (articles and determiners), verb and tense, subject-verb agreement, clause, and sentence structure, making question (wh-question, yes/no questions, tag question), conjunction, preposition, active and passive voice	12 hrs	CLO1 CLO2 CLO3
2.	Reading: Reading comprehension (scanning and skimming, summarizing, critical reasoning)	6 hrs	CLO1 CLO3
3.	Writing: Basics of paragraph and essay writing, CV writing, cover letter, joining and resignation letter.	6 hrs	CLO1, CLO2 CLO3
4.	Public communication: Formal and informal English, spoken discourse, presentation.	6 hrs	CLO1 CLO2
5.	Improvement of English proficiency: a) Arguments for and against ideas in discussions and writing on different topics. b Verbal reasoning, quantitative reasoning and analytical writing on famous poetry, novel etc.	12 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
				10-20%	10-20%	20-30%	20-30%	20-30%	20-30%	
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Intermediate English Grammar – Raymond Murphy
2. ABC of English Grammar – Jahurul Islam
3. Houghton Mifflin English Grammar and Composition - Anne Cole Brown
4. Exercises in Reading Comprehension - E.L. Tibbitts
5. A Handbook of Paragraph Writing – Jahurul Islam
6. From Paragraph to Essay – Maurice Imhoof and Herman Hudson
7. How to Write First Class Business Correspondence – L. Sue Baugh, Maridell Fryer and David A. Thomas
8. Model Business Letters, Emails and other documents – Shirley Taylor
9. Function in English – Jon Blundell, Jonathan Higgins and Nigel Middlemiss
10. A course in Listening and Speaking I & II – V. Sasikumar, P. Kiranmai Dutt and Geetha Rajeeva.

Course Code	0916-115
Course Title	Inorganic Pharmaceutical Chemistry Lab
Year & Semester	1st Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This lab course covers the basics of inorganic pharmaceutical chemistry, including how to recognize inorganic compounds (salts) and how to test for them, as well as how to prepare inorganic pharmaceuticals and how to use them in the pharmacy. This course focuses on qualitative and quantitative analysis of acid and basic radicals.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Handle laboratory apparatus with ensuring general precautions, safety measures and maintenance.
CLO2	Identify unknown inorganic compounds by qualitative and quantitative measurement of different inorganic salts in samples.
CLO3	Demonstrate how inorganic pharmaceuticals are manufactured and how they are used in pharmacies and calibrate and correct use of various types of equipment.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓		✓	✓		✓
CLO2	✓		✓					✓
CLO3	✓		✓					✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Laboratory Safety Rules and Regulations	4 hrs	CLO1
2.	Introduction to Laboratory Instruments	4 hrs	CLO1
3.	Identification and Use of Laboratory Apparatus	4 hrs	CLO1
4.	Qualitative analysis of basic radicals: Na, K, Ca, Ag, Mn, Fe	4 hrs	CLO2
5.	Qualitative analysis of basic radicals: Co, Mg, Al, NH ₄ , Cu	4 hrs	CLO2
6.	Qualitative analysis of acid radicals: CO ₃ , halides, citrates, SO ₄ , SO ₃ , NO ₃ , etc.	4 hrs	CLO2
7.	Identification of unknown inorganic salts by qualitative analysis.	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Modern Inorganic Chemistry- S. Z. Haider
2. Inorganic Chemistry- Lee
3. Textbook of Inorganic Pharmaceutical Chemistry- Rogers
4. Inorganic, Medicinal and Pharmaceutical Chemistry- Block and Wilson
5. Vogel's Text Book of Quantitative Chemical Analysis, Latest Edition.

Course Code	0916-116
Course Title	Organic Pharmaceutical Chemistry Lab
Year & Semester	1st Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course is complementary part to the theoretical lectures provided by the co-requisite course. The laboratory is divided into two parts. The first part provides an adequate coverage of safety precautions and lab rules that students should strictly follow so that safety can be achieved in the lab and the experiments are designed to familiarize students with techniques commonly used in the organic laboratory. The second part provides qualitative analysis of organic compounds.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Extend their skills about handling of laboratory equipment and their safety issues.
CLO2	Demonstrate qualitative analysis and purity test of organic molecules and apply their theoretical knowledge to practical.
CLO3	Identify the melting point of different molecules.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓			✓		✓
CLO2	✓	✓	✓			✓		✓
CLO3	✓	✓	✓					✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Qualitative analysis of organic compounds Detection of elements	8 hrs	CLO1, CLO2 CLO3
2.	Qualitative analysis of organic compounds Identification of functional group (-CO)	2 hrs	CLO1, CLO2 CLO3
3.	Qualitative analysis of organic compounds Identification of functional group (-CO)	2 hrs	CLO1, CLO2 CLO3
4.	Qualitative analysis of organic compounds Identification of functional group (-COOH)	2 hrs	CLO1, CLO2 CLO3
5.	Qualitative analysis of organic compounds Identification of functional group (Phenol)	2 hrs	CLO1, CLO2 CLO3
6.	Qualitative analysis of organic compounds: Determination of melting points	4 hrs	CLO3
7.	Qualitative analysis of organic compounds: Test of purity.	8 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Evaluation	15.5%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Introduction to Organic Chemistry- Bahl and Bahl
2. Organic Chemistry- Morrison and Boyd
3. Organic Chemistry (Vol I and II)- Finar
4. Fieser's Reagents for Organic Synthesis – Feiser
5. Vogel's Text Book of Practical Organic Chemistry, New Edition.

Course Code	0916-117
Course Title	Physical Pharmacy-I Lab
Year & Semester	1st Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course is designed to provide the pharmacy students with practical experiences in physical pharmaceutical science essential to study relevant course in the next years. The course also aims to provide students with a fundamental understanding of how to make various types of solutions as well as practical experience in determining the concentration of unknown solutions, preparation of primary and secondary standard solutions, and determination of strength of unknown solution by titration methods, determination of molecular weight of substances and determination of integral heat of solution.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Develop the practical knowledge for handling laboratory apparatus with ensuring general precautions, safety measures and maintenance.
CLO2	Prepare standard solution, solution of specific strength as well as determine strength of unknown solution, molecular weight, integral heat of solution, distribution co-efficient and heat of neutralization of substances.
CLO3	Apply the basic concepts and practical experiences in the pharmaceutical industry as well as research laboratory.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓			✓			✓
CLO2	✓	✓		✓				✓
CLO3	✓	✓				✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Preparation of primary standard solutions	4 hrs	CLO1 CLO3
2.	Preparation of secondary standard solutions	4 hrs	CLO1 CLO3
3.	Determination of strength of strong acid and weak acid by primary standard base	4 hrs	CLO1 CLO3
4.	Determination of strength of strong base with primary standard acid	4 hrs	CLO1 CLO3
5.	Determination of strength of strong base with strong acid	4 hrs	CLO1 CLO3
6.	Determination of integral heat of solution of KCl, NH ₄ -Cl and NaCl	4 hrs	CLO2
7.	Determination of heat of neutralization of HCl with NaOH	4 hrs	CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Handbook of Practical Pharmaceutical Chemistry (A systematic approach to titrimetric analysis)- R. K. Sing
2. Principle of Physical Chemistry- Haque and Nawab
3. Physical Chemistry- P. W. Atkins
4. Martin's Physical Pharmacy-A. Martin and J. Swarbrick
5. Essential of Physical Chemistry- Bahl and Tuli

Course Code	0916-118
Course Title	Pharmacognosy-I Lab
Year & Semester	1st Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course will provide students with basic knowledge and understanding of the scientific name of the medicinal plants, family, synonyms(s), English name, local name, parts used and also the active constituents of each plant, structure of the main constituents.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Handle laboratory apparatus with ensuring general precautions, safety measures and maintenance.
CLO2	Acquire basic skills in using the microscope to identify several carbohydrates.
CLO3	Develop knowledge about crude drug.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓		✓	✓		
CLO2	✓	✓		✓	✓	✓		
CLO3	✓	✓	✓	✓	✓	✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Study on some medicinal plants	4 hrs	CLO3
2.	Identification of plant leaves, their botanical name, nature, and medicinal uses. (Neem, Tulsi, Kalomegh, Nayantara, Sarpagandha, Patharkuchi, Arhor)	4 hrs	CLO1 CLO3
3.	Identification of plant leaves, their botanical name, nature, and medicinal uses.(MuktaJuri,Tridhara,Datura, Arjun,Talacucha,Mandar)	4 hrs	CLO1 CLO3
4.	General tests of Carbohydrates (Glucose)	4 hrs	CLO2
5.	General tests of Carbohydrates (Fructose)	4 hrs	CLO2
6.	General tests of Carbohydrates (Xylose)	4 hrs	CLO2
7.	General tests of Carbohydrates (Lactose)	4 hrs	CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Pharmacognosy- Tyler and Brady
2. Pharmacognosy- E. P. Claus and V.E. Tyler
3. Trease and Evan's Pharmacognosy - W.C. Evans
4. Textbook of Pharmacognosy - Mohammad Ali

Course Code	0916-121
Course Title	Organic Pharmaceutical Chemistry-II
Year & Semester	1st Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The course is designed to provide advanced knowledge of organic chemistry to the students of Pharmacy. The course includes studies of the mechanism of organic reactions, preparation of organometallic compounds and the chemistry of natural compounds (carbohydrates, lipids, amino acids and proteins).

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Design a synthetic pathway of organic compounds applying important organic reactions.
CLO2	Demonstrate the structure and physico-chemical properties of different organometallic compounds.
CLO3	Describe and apply the knowledge regarding the nature, properties and synthesis of natural products (carbohydrates, lipids and proteins).

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				✓
CLO3	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Mechanism of Organic Reactions: Baeyer-Villiger and Birch reduction, Clemmensen reduction. Diels Alder reaction, Eschweiler-Clarke reaction, Friedel-Crafts alkylation and acylation reaction, Gabriel synthesis, Gattermann-Koch and Sandmeyer reaction, Grignard reaction, Hoffman degradation reaction, Mannich reaction, Michael and MeerwinPondorf-Verley reduction, Oppenauer oxidation, Perkin reaction, Reformatsky reaction, Reimer-Tiemann reaction, Wittig and Wolf-Kishner reduction.	12 hrs	CLO1
2.	Organometallic compounds: Preparation of organometallic compounds containing lithium, magnesium, copper, cadmium, zinc and their importance.	6 hrs	CLO2
3.	Carbohydrates: Chemistry, isomerism, stereochemistry, aldoses, ketoses oxidation, effect of alkali, synthesis of aldoses and ketoses by various methods, optical activity, hemiacetal and acetal forms of glucose, ring size determination, disaccharides, structure determination of polysaccharides, starch, cellulose, glycogen.	6 hrs	CLO3
4.	Lipids: Chemistry, biosynthesis of fats and fatty acids, catabolism, fatty acid cycle, -oxidation, ketone bodies, ketosis, ketouria, ketoacidosis, lactic acid and acidosis, phosphoglycerides, bile salts.	4.5 hrs	CLO3
5.	Amino acids, Peptides and Proteins: Introduction, definition, structure, acidity and basicity, iso-electric point, relations and chemical synthesis of amino acids, essential and nonessential amino acids, peptide synthesis and denaturation, classification, important reactions, sequence determination, test of purity, protein as drugs.	13.5 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Introduction to Organic Chemistry- Bahl and Bahl
3. Organic Chemistry- Morrison and Boyd
4. Organic Chemistry (Vol I and II)- Finar
5. Feisers' Reagents for Organic Synthesis- Fieser

Course Code	0916-122
Course Title	Physical Pharmacy-II
Year & Semester	1st Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Physical pharmacy is a fundamental course that integrates knowledge of mathematics, physics and chemistry and applies them to the pharmaceutical dosage form development. The course aims at introducing important pharmacy related physical principles in areas such as reaction kinetics and stability of pharmaceuticals, phase equilibria, thermodynamics, electrochemistry, surface and interfacial phenomena and rheology. Physical pharmacy provides the basis for understanding the chemical and physical phenomena that govern the in vivo and in vitro actions of pharmaceutical products.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Demonstrate reaction kinetics and stability of pharmaceuticals such as chemical kinetic, drug decomposition, stabilization of drug or medicinal products, accelerated stability testing.
CLO2	Analyze phase equilibria study, which is about phase, phase rule, thermodynamic deviation, lyophilization, phase diagram of water and sulphur system etc.
CLO3	Evaluate the second and third laws of thermodynamics, Gibb's free energy, conductance of electrolytes, electrode, E.M.F concept, various type of electrochemical cells, oxidation reduction, relation between electrical and chemical energies, buffer solution, measurement of pH, potentiometric titration etc.
CLO4	Develop knowledge about adsorption and interface, Nernst and Zeta potential, Gibb's equation, surfactant and drug activity etc.
CLO5	Create knowledge about Newtonian and non-Newtonian systems, dilatant flow, thixotropy, rheologic properties, viscoelasticity, psychorheology, application in pharmacy.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓					✓		✓
CLO2	✓	✓						✓
CLO3	✓	✓				✓		✓
CLO4	✓		✓			✓		✓
CLO5	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Reaction Kinetics and stability of pharmaceuticals: Chemical kinetics, drug decomposition, stabilization of medicinal products, accelerated stability testing and catalysis.	3 hrs	CLO1
2.	Phase equilibria: Phase, components and degree of freedom, the phase rule, and its thermodynamic deviation, The phase diagram of water and sulphur systems, partially miscible liquid pairs: the phenol and water, nicotine and water system, Completely miscible liquid pairs and their separation by functional distillation, Freeze drying (lyophilization).	9 hrs	CLO2
3.	Second and third laws of thermodynamics: Second law of thermodynamics entropy, Gibb's free energy, third law of thermodynamics.	3 hrs	CLO3
4.	Electrochemistry: a) Conductance of electrolytes, concept of E. M. F, electrode, various types of electrochemical cells, relation between electrical and chemical energies, oxidation-reduction systems, solutions of electrolytes. b) Electrode and cell potentials, energies involved in electrode processes; reference electrodes, buffer solutions, measurement of pH, potentiometric titration, concentration cell etc.	9 hrs	CLO3
5.	Surface and interfacial phenomena: Adsorption and interface, Freundlich and Langmuir isotherm, BET equation, electrical properties of interface, electrical double layer, Nernst and Zeta potential, Gibb's equation, spreading and surface-active agent emulsifier, detergents and antifoaming agents, surfactants and drug activity, surfactants and pharmaceutical products.	9 hrs	CLO4
6.	Rheology: Newtonian and non-Newtonian systems, yield value, plastic, pseudoplastic and dilatant flow, thixotropy. Determination of rheologic properties, viscoelasticity, psychorheology, application in pharmacy. Rheologic property of suspension.	9 hrs	CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Principle of Physical Chemistry- Haque and Nawab
2. Physical Chemistry- Atkins
3. Martin's Physical Pharmacy- Martin
4. Principle of Physical Chemistry- Haque and Nawab.
5. Elements of Physical Chemistry- Lewis and Glasstone

Course Code	0916-123
Course Title	Physiology and Anatomy-I
Year & Semester	1st Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Physiology and Anatomy-I gives the instruction in the organization, structures, and functions of the human body. The aim of this study is to introduce different parts of the body like cell, blood, blood circulatory system, heart, liver, lymphoid, digestive system and respiratory system to students. Moreover, this course helps the students to gain in-depth knowledge about how the chemical and physical functions and maintain the homeostatic conditions that exist in human body. The topics and contents are designed to focus on all areas of human physiology as well as human anatomy.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Demonstrate the morphology, coordination and working pattern of different organs of each system of the human body and describe various procedures of laboratory techniques like blood group determination, blood pressure measurement, blood cell counting and interpret their results.
CLO2	Analyze and evaluate various homeostatic mechanisms, their imbalances in human health and determine the potential physiological consequences.
CLO3	Develop skills to recognize and modify clinical, pharmacological and physiological procedures and assays.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				✓
CLO3	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Cell and tissue: a. Cell: Structure and function, cell inclusions, cell division. b. Tissue: Definition, classification, structures and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.	6 hrs	CLO1
2.	Body fluid: Fluid compartments, volume, and composition of ECF, ICF, maintenance and regulation of fluid volumes and their compositions.	3 hrs	CLO1 CLO2 CLO3
3.	Blood: a) Plasma: Electrolytes, proteins and other organic constituents. b) Blood cells: Formation and destruction, cell constituents, functions of different blood cells. c) Hemoglobin: Structure and function, haemoglobinopathy, thalassemia. d) Anemia: Causes and classification. e) Blood coagulation and anticoagulation. f) Blood group and transfusion.	9 hrs	CLO1 CLO2 CLO3
4.	Lymph: Composition, function, circulation and function of lymph nodes and lymphatics.	3 hrs	CLO1
5.	Cardiovascular system: a) Heart: Structure and properties of cardiac muscles, conduction system of heart, cardiac cycle, heart sound, cardiac out-put and ECG. b) Blood vessels: Type of blood vessels and their function. c) Blood pressure (BP): Measurements and regulation of BP, control of BP (neural and humoral). d) Regional blood circulation: Pulmonary, hepatic, cerebral, capillary and coronary circulation.	9 hrs	CLO1 CLO2 CLO3

6.	Digestive system: Structure of the different parts of the alimentary tract, composition, function and regulation of the secretion of different digestive juices, digestion and absorption of food stuffs, movement of alimentary tract	4.5 hrs	CLO1 CLO2 CLO3
7.	Respiratory system: Functional anatomy of the respiratory system, mechanism of respiration, lung volumes and capacities, gaseous exchange and transport (O ₂ and CO ₂), regulation of respiration (nervous and chemical), hypoxia-causes and classification, periodic (abnormal) breathing, Cheyne- stokes breathing, Kussmaul breathing and breathing at high altitude.	6 hrs	CLO1 CLO2 CLO3
8.	Functions of different organs- Liver, spleen, kidney	1.5 hrs	CLO1

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Review of Medical Physiology, W. F. Ganong
2. Human Physiology, C. C. Chatterjee
3. A Text Book of Medical Physiology. Gyton
4. Human Physiology, Chakrabarti, Ghos and Sahana

Course Code	0916-124
Course Title	Pharmacognosy-II
Year & Semester	1st Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The American Society of Pharmacognosy defines Pharmacognosy as “the study of the physical, chemical, biochemical and biological properties of drugs, drug substances or potential drugs or drug substances of natural origin as well as the search for new drugs from natural sources.” The course provides an overview of the field of natural product chemistry and is designed to acquaint the student with the occurrence, chemical constituents and pharmacological uses of biologically active natural products.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Acquire basic knowledge of important medicines originating from nature and how nature can be a resource for the development of new drugs.
CLO2	Describe different types of secondary metabolites (alkaloids, glycosides, volatile oils, resins and tannins), their general properties, classification, test for identification and isolation techniques.
CLO3	Explain the therapeutic value and toxicology of natural constituents.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				✓
CLO3	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Phytochemistry and pharmaceutical uses of the following plant constituents: I. Glycosides and glycoside-containing drugs: Definition, classification and biosynthesis of glycosides. a) Phenols and phenolic glycosides: i) Simple phenols: vanilla, capsicum. ii) Tannins: galls or nutgall, hamamelis. iii) Anthraquinone glycosides: cascara sagrada, aloe, senna, rhubarb. b) Saponins, cardioactive drugs and other steroids. i) Steroidal saponin: sarsaparilla root, ginseng, glycyrrhiza. ii) Pentacyclic triterpenoid saponin: liquorice root. Cardioactive glycosides: digitalis, strophanthus, iii) squill. Cyanogenic glycoside: wild cherry, mustard. iv) Miscellaneous: gentian, valerian root, quassia, fish berries, santonica flower, saffron. v)	10.5 hrs	CLO1 CLO2 CLO3
	II. Alkaloids: a) Definition, properties, classification and chemical tests of alkaloids. Biosynthesis of tropane, quinoline, isoquinoline and indole alkaloids. b) Tropane: belladonna, stramonium, hyoscyamus and coca leaf. c) Quinoline: cinchona, cusparia bark. d) Isoquinoline: ipecac, opium, sanguinaria, curare. e) Indole: rauwolfia, nux vomica, ergot, catharanthus. f) Imidazole: pilocarpine. g) Steroidal: veretrumviride, aconite. h) Norlupinane: lupinus sp. i) Purine base: coffee, tea and cocoa.	10.5 hrs	CLO1 CLO2 CLO3

	III. Volatile oils and related terpenoids: Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oil. a) Terpenes or sesquiterpenes: turpentine. Alcohols: coriander, sandalwood, rose. b) Esters: peppermint, lavender, rosemary. c) Aldehydes: cinnamon bark, lemon peel, lemon grass. d) Ketones: spearmint, caraway, dill, camphor. e) Phenols: clove, thyme, cinnamon bark, ajowan f) Ethers: fennel, nutmeg, eucalyptus, anise, cajunut. f) Peroxides: Chenopodium. g) Others: wintergreen, bitter almond. h)	10.5 hrs	CLO1 CLO2 CLO3
2.	Poisonous plants and natural pesticides: Datura, poison hemlock, water hemlock, ipomoea, tobacco, pyrethrum flower, derris, lonchocarpus, strychnine, neem etc.	3 hrs	CLO3
3.	Phenolic compounds and tannins: Chemical nature and tests for tannins, some tannin containing drugs such as nutgall and catechu.	3 hrs	CLO1 CLO2
4.	Resin and resin combinations: Definition, classification, chemical tests and properties. Study of Jalap, cannabis, capsicum, ginger, myrrh, tolu balsam, and benzoin.	4.5 hrs	CLO1 CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Pharmacognosy- Tyler and Brady
2. Pharmacognosy- E. P. Claus and V.E. Tyler
3. Trease and Evan's Pharmacognosy - W.C. Evans
4. Textbook of Pharmacognosy - Mohammad Ali

Course Code	0611-003
Course Title	Computer Fundamental
Year & Semester	1st Year 2nd Semester
Course Credit	2
Credit Hours	28
Total Marks	80

Course Description:

In this introductory course, students will become familiar with concepts of computer basics including hardware and peripherals, software, data processing and networking. Students will gain knowledge on history and development of computers and impact of computers on society. The overall aim of this course is to provide basic competencies for application of a computer to everyday tasks.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the fundamental concept of computer and its different parts as well as the usage of computers in pharmaceutical science and society.
CLO2	Explain the role of software in data processing thereby using the computer for personal and professional purpose.
CLO3	Apply various types of networks, network standards, internet system to communicate with the global society.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓					✓
CLO2	✓	✓	✓					✓
CLO3	✓	✓	✓			✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Computer basics: Concept of computing, history & generations of computer, algorithms & flowcharts, types of computers.	4 hrs	CLO1 CLO2 CLO3
2.	Computer hardware and peripherals: Basics of computer hardware, central processing unit, input/output devices, memory and storage, network devices, computer interfacing.	6 hrs	CLO1 CLO2 CLO3
3.	Software: Software and its classifications, system software & application software, different operating systems, computer virus, software maintenance. I. Word processing (MS word): Creating, saving and updating document, components of editor, document formatting & printing, advanced editing facilities, working with table, symbols, equation, pictures and drawing, envelopes, labels, mail merge. II. Spreadsheet analysis (MS excel): Concept of spreadsheet, illustration of cell, number and formatting of cell, inserting and deleting of row & column, changing height & width; freezing & unfreezing pane, hiding and unhiding of row and column, paste special, auto fill, working with formulas, conditional formatting, sorting, data filtering, chart and graphs, report printing. III. Presentation software (power point): Creating, formatting and editing presentation, inserting and deleting slides, viewing slides, applying design, slide transition, animation, embedding audio & video, slide show.	12 hrs	CLO2 CLO3
4.	The Internet: The world wide web, getting connected to the web, browsing, search engines, locating information on the web, email.	6 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Introduction to Computer- Peter Norton
2. Computer Systems- J. Stanley Warford
3. Computer Fundamentals- Dr. M. Lutfar Rahman and Dr. M. Alamgir Hossain
4. Computers and Business Information Processing- William S. Davis
5. Introduction to Computers- Subramanian

Course Code	0916-125
Course Title	Physical Pharmacy-II Lab
Year & Semester	1st Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

The course aims at introducing important pharmacy related physical principles in areas such as reaction kinetics. It provides the basis for understanding the chemical and physical phenomena that govern in vivo and in vitro actions of pharmaceutical products.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Extend the skills to handle laboratory apparatus with ensuring general precautions, safety measures and maintenance and prepare standard solution, solution of specific strength and different types of buffers.
CLO2	Analyze viscosity of different liquid and develop knowledge about general laboratory safety and precautions along with maintenance and documentation of records in the laboratory.
CLO3	Provide practical experiences to students on the preparation of standard solution and solution of specific strength from stock solution.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓		✓	✓	✓
CLO2	✓	✓		✓			✓	
CLO3	✓	✓		✓			✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Determination of viscosity of pure liquids such as glycerin or alcohol using Ostwald viscometer	4 hrs	CLO2
2.	Study of variation of a liquid with temperature using Ostwald viscometer	4 hrs	CLO2
3.	Determination of the strength and titration curve of a weak base by pH-metric titration with a strong acid	4 hrs	CLO1 CLO3
4.	Determination of the strength and titration curve of a weak acid by pH-metric titration with a strong base	4 hrs	CLO1 CLO3
5.	Determination of solubility of a sparingly soluble salt in water by conductance measurement	4 hrs	CLO1 CLO3
6.	Determination of Critical Micelle Concentration (CMC) of ionic surfactant by conductance measurement	4 hrs	CLO1 CLO3
7.	Determination of dissociation constants of some organic weak acids by potentiometric method	4 hrs	CLO1 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Principle of Physical Chemistry- Haque and Nawab
2. Physical Chemistry- Atkins
3. Martin's Physical Pharmacy- Martin
4. Essential of Physical Chemistry- Bahl and Tuli
5. Elements of Physical Chemistry- Lewis and Glasstone

Course Code	0916-126
Course Title	Physiology and Anatomy-I Lab
Year & Semester	1st Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course is designed to provide knowledge on how different physiological processes of human body works. This will expand information on some physiological functions like blood circulatory system, heart activities and blood cell biology. This will also provide practical knowledge how different systems interact to yield integrated physiological responses to challenges such as exercise fasting and high altitude and how they can fail.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Perform, analyze and report on experiment and observations in physiology.
CLO2	Analyze heart function by checking key parameters like blood pressure.
CLO3	Develop practical biological skills on different blood cell and its component.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1		✓					✓	
CLO2				✓		✓		
CLO3	✓	✓						

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Microscopically study of different types of blood cells (RBC&WBC)	8 hrs	CLO1 CLO3
2.	Examination of hemoglobin	4 hrs	CLO1 CLO3
3.	Determination of clotting time	2 hrs	CLO1 CLO3
4.	Determination of bleeding time	2 hrs	CLO1 CLO3
5.	Determination of Erythrocytes Sedimentation Rate (ESR)	4 hrs	CLO1 CLO3
6.	Determination of blood group	4 hrs	CLO1 CLO3
7.	Measurement of blood pressure by sphygmomanometer	4 hrs	CLO1 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Laboratory manual for Anatomy and Physiology: Connie Allen
2. Practical Book on Human Anatomy and Physiology: Prof. Satish K. Mandlik

Course Code	0916-127
Course Title	Pharmacognosy-II Lab
Year & Semester	1st Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmacognosy-II Lab is a practical course which is designed to conduct the extraction of caffeine from tea and coffee, extraction of alkaloid from stramonium, separation of different compounds from plant extracts by thin layer chromatography, study of volatile oils and some volatile-oil containing drugs as well as study of alkaloids and some alkaloid-containing drugs. In this course the students will gain the primary knowledge and practical experiences of the general methods of extraction, isolation, purification and identification of bioactive natural compounds. Moreover, the students will also get basic idea how to identify and separate compounds by thin layer chromatography

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Acquire competency in routine and specialized laboratory skills regarding extraction and isolation of bioactive compounds as well as thin layer chromatographic technique.
CLO2	Analyze experimental results and develop skills for analytical arguments clearly and concisely, both verbally and in writing.
CLO3	Apply the basic concepts and practical experiences in the next pharmaceutical industry as well as research laboratory.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓			✓			
CLO2	✓	✓	✓	✓		✓		
CLO3		✓			✓	✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Extraction of caffeine from tea leaves	4 hrs	CLO1,CLO2 CLO3
2.	Extraction of caffeine from coffee	4 hrs	CLO1,CLO2 CLO3
3.	Extraction of alkaloid from Datura stramonium	4 hrs	CLO1,CLO2 CLO3
4.	Chromatographic techniques: Separation of different compounds from plant extracts by thin layer chromatography	4 hrs	CLO1,CLO2 CLO3
5.	Study of volatile oils and some volatile-oil containing drugs: Caraway, clove, cinnamon, peppermint	4 hrs	CLO1,CLO2 CLO3
6.	Study of alkaloids and some alkaloid-containing drugs: Belladonna, stramonium, cinchona, rauwolfia, tea, coffee, tobacco, ergot, ephedra, nux vomica and areca	4 hrs	CLO1,CLO2 CLO3
7.	Study of few important cardioactive drugs: Digitalis, strophanthus and squill	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Comprehensive Organic Chemistry Experiments for the Laboratory Classroom, Chapter: Caffeine extraction from tea and coffee- Madureira AM, Viera AJSC and Ferreira MJU.
2. Thin-Layer Chromatography: A Modern Practical Approach- Peter E Wall
3. Pharmacognosy- Tyler and Brady
4. Pharmacognosy- E. P. Claus and V.E. Tyler
5. Trease and Evan's Pharmacognosy - W.C. Evans
6. Textbook of Pharmacognosy - Mohammad Ali

Course Code	0916-128
Course Title	Oral Assessment- I
Year & Semester	1st Year 2nd Semester
Course Credit	1
Credit Hours	15
Total Marks	100

Course Description:

Oral Assessment is a Latin expression that was used in Catholic seminary education to refer to oral exams (it literally means, “living voice”). Oral exams are used not as a substitute, but as a complementary to written exams. They are a way to ask what is not feasible through the written format. Ostensibly, the rationale is that teachers can use the oral format to probe, challenge, and critically assess what a student really knew about a particular topic.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate the vocal depth of comprehension, critical thinking and problem-solving skills.
CLO2	Interact with courage and spontaneity beyond nervousness in face-to-face interview.
CLO3	Present their concepts orally in a methodical manner and demonstrate preparedness for a future job interview.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓			✓		
CLO2				✓	✓		✓	✓
CLO3		✓			✓	✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	All courses of 2nd semester	15 hrs	CLO1,CLO2 CLO3

Teaching- Learning Approach	Assessment Strategy		Positive Reinforcement Tasks
Discussion of lecture Overview of courses Question-Answer session Text books PowerPoint lecture notes Websites Videos/Documentaries Scientific articles	Attendance	10 %	Feedback/Response Individual discussion Group discussion Misconception check Summarization of lecture
	Viva (Attire, Attitude, Speaking, Knowledge)	90 %	
	Total	100%	

Learning References:

1. All textbooks of this semester.

Course Code	0916-211
Course Title	Pharmaceutical Analysis-I
Year & Semester	2nd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course is devoted to the exploration of principles of qualitative and quantitative analysis, methods expressing the concentrations, principles of volumetric analysis, acid-base equilibria in aqueous solutions, acid-base titration, and their applications in both solutions as well as the precipitation equilibria, oxidation-reduction equilibria and applications of gravimetric methods.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate the importance of substance determination and explain the difference between qualitative and quantitative analysis.
CLO2	Analyze a strong theoretical and practical grounding in the principles and practices of analytical chemistry, including different types of titrations and their applications and the fundamentals of gravimetric analysis.
CLO3	Evaluate in product quality control to maintain accuracy of a product by developing the knowledge about all types of titrations, moisture content determination, sampling and microbiological analysis of vitamins and antibiotics.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓		✓		✓
CLO2	✓	✓		✓		✓		✓
CLO3	✓	✓		✓		✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction of Pharmaceutical Analysis: Importance of both qualitative and quantitative analysis in pharmaceutical quality control. Sampling, precision and accuracy of representative samples, methods of expressing concentrations, primary and secondary standards.	3 hrs	CLO1
2.	Aqueous Acid-Base Titrations: Acid base concepts, distribution of acid base species with pH of the medium acid-base titration for determination of weakly acidic and basic pharmaceuticals. Indicator's theory, selection and applications.	9 hrs	CLO2 CLO3
3.	Oxidation-Reduction Titrations: Principles and concepts. Determination involving potassium permanganate, potassium dichromate and potassium bromide and iodometric determination, miscellaneous oxidation and reduction titrations, indicators and applications.	9 hrs	CLO2 CLO3
4.	Complexometric Titrations: Introduction, complexes and chelates, stability of complex ions, titrations based on complex formation types of complexometric titrations technique employed in chelatometric titration, methods of end point detection, titration selectivity and masking reagents.	7.5 hrs	CLO2 CLO3
5.	Non-aqueous Acid Base Titrations: Theoretical considerations and principles, of Bronsted Lowry theory of acids and bases, non-aqueous solvents. Titration of weak acids and weak bases applications and scope of non-aqueous titration.	6 hrs	CLO2 CLO3
6.	Determination of Moisture Content in Pharmaceutical products: Principle and scope, physical and chemical methods of water determination. Karl-Fischer principle. Procedure, chemistry, methodology, equipment, end point defection and limitations.	4.5 hrs	CLO2 CLO3
7.	Principles of Microbiological analysis of Antibiotics and vitamins: Definition, factors affecting the microbial contamination, principles of microbiological analysis, bioassay of antibiotics, vitamins, microbial count for antacids and water.	3 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Quantitative Pharmaceutical Analysis (Vol I &II)-Chatten
2. A Textbook of Pharmaceutical Analysis – K. A. Connors
3. Quantitative Inorganic Analysis (Vol I & II)- Vogel
4. British Pharmacopoeia
5. United State Pharmacopoeia.

Course Code	0916-212
Course Title	Microbiology and Immunology
Year & Semester	2nd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Microbiology involves the study of microscopic organisms, such as bacteria, viruses, algae, archaea, fungi and protozoa. It includes the fundamental principles of Microbiology examining the microorganisms that occupy our planet and their effects on the biosphere and their impact on human and the environment. This course includes various groups of microorganisms, their structure, evolution, characteristics, classification, general principles of growth, pathogenicity and the functions of microorganisms. Microscopy with basic microbiological techniques such as sterilization, staining procedures, culture methods are also included in the course that is to be applied in the laboratory for identification of unknown bacteria. The immunology part of this course has been designed to teach students about the core ideas of the immune system's defense against pathogens.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe the general principles of microorganisms, history of evolution, the nature of pathogenesis, laboratory diagnosis, transmission, prevention and control of microbial diseases common in the country.
CLO2	Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation, etc.
CLO3	Develop the general knowledge regarding immune system against microorganisms.
CLO4	Develop the practical knowledge how to handle microscope, sterilization procedures and culture of bacteria.
CLO5	Apply the basic concepts of microbiology in different fields such as medical, industrial, environment, genetics, agriculture, etc.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2	✓			✓			✓	✓
CLO3	✓							
CLO4		✓			✓			
CLO5		✓			✓	✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: a) Historical development, scope of microbiology with special reference to pharmaceutical sciences. b) Microscopy: Bright field, dark field, fluorescence, phase contrast and electron microscopy. Microscopic examination of microorganisms, wet mount and hanging drop techniques. Microbial staining.	6 hrs	CLO1 CLO4 CLO5
2.	Virus: a) General properties, classification and nomenclature, morphology, multiplication and cultivation. b) Bacteriophage: Morphology and life cycle. c) SARS-Cov-2: Morphology, genome organization, life cycle, pathogenesis, and prevention.	12 hrs	CLO1 CLO2 CLO5
3.	Bacteria a) General characteristics of bacteria. b) General and cellular morphology - size, shape, fine structures and movement. c) Cultivation of bacteria: Nutritional requirements, factors affecting growth, bacteriological media. d) Reproduction and growth: Modes of cell division, normal growth cycle, growth curve, synchronous growth and measurement of growth. e) Pure culture and cultural characteristics: Methods of isolation, maintenance and preservation of pure cultures, colony characteristics and characteristics of broth culture.	12 hrs	CLO1 CLO2 CLO4 CLO5
4.	a) Fungi: Morphology, classification, pharmaceutical importance, etc. b) Brief study of rickettsia and actinomycetes.	6 hrs	CLO1 CLO2 CLO5
5.	Fundamentals of immunology: a) Immunity, immune response, types of immunity, antigens, haptens and antibodies b) Hypersensitivity reactions: Introduction, immediate hypersensitivity (type I, II and III) and delayed hypersensitivity (type IV)	6 hrs	CLO3 CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Microbiology- Pelczar, Kreig and Chan
2. Microbiology-Application and Concept- Pelczar, Chan and Krieg
3. Microbiology: An Introduction- Tortora, Funkee and Case
4. Pharmaceutical Microbiology- Harris
5. Modern Medical Microbiology- M. R. Choudhury
6. Prescott and Dunn's Industrial Microbiology
7. Kumar S, Nyodu R, Maurya VK, Saxena SK. Morphology, genome organization, replication, and pathogenesis of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Coronavirus Disease 2019 (COVID-19). 2020:23.
A text book of Immunology- A K Akram
8. Review of Medical Microbiology and Immunology- Warren Levinson.
- 9.

Course Code	0916-213
Course Title	Physiology and Anatomy-II
Year & Semester	2nd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Physiology is a branch of biology that deals with the study of how the systems of the body work and the ways in which their integrated cooperation maintains life and health of the individual. It explains the physical and chemical factors that are responsible for the origin, development and progression of life. Physiology also describes the specific characteristics and mechanism of the human body that make it a living being.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate the structure and functional properties of different organ system.
CLO2	Identify the hormonal regulation and control on different organ system and disorder of endocrine glands.
CLO3	Evaluate the factors affecting body temperature and study of various metabolic pathway of human body.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓	✓		✓	✓
CLO2	✓	✓	✓	✓			✓	
CLO3	✓		✓				✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Nervous system: Properties of nerve, cells, nerve impulses and their transmissions, reflex action, principal afferent and efferent paths of CNS, functions of spinal cord and brain, the autonomic nervous system, properties of synapses and synaptic transmission.	9 hrs	CLO1
2.	Metabolism: Metabolism of fats, carbohydrates, protein and nucleoprotein, vitamins and minerals, their physiological properties and function,	6 hrs	CLO1 CLO3
3.	Excretory system: Structure and function of kidney, composition and formation of urine, renal circulation, renal regulation of acid base balance, renal diseases and kidney function tests, physiology of micturition, artificial kidney: basic principles, method and applications.	6 hrs	CLO1
4.	Temperature control: Heat production and heat dissipation, hypothalamus and nervous factors involved in body temperature regulation, function of skin.	6 hrs	CLO3
5.	Endocrine glands: Structure and functions of thyroid, parathyroid, pituitary and adrenal glands, hypothalamus and pancreas.	9 hrs	CLO1 CLO2
6.	Reproduction: Structure and function of testis, ovary, uterus and placenta, menstrual and oestrous cycles, diagnosis of pregnancy, oestrogen, progesterone, androgens and gonadotropic hormones.	6 hrs	CLO1 CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Human Physiology (Vol I & II)– C. C. Chatterjee
2. Textbook of Medical Physiology – Guyton and Hall.
3. Review of Medical Physiology– W. F. Ganon

Course Code	0916-214
Course Title	Basic Pharmaceutics
Year & Semester	2nd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Basic Pharmaceutics discuss the physicochemical principles of preformulation, excipients for pharmaceutical dosage forms and pharmaceutical incompatibility. It integrates the physical, chemical and mathematical principles to introduce terminologies, theories, calculations and strategies of formulation design and quality control. The commonly used pharmaceutical ingredients, methods of preparation, manufacturing and quality evaluation are also introduced.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe fundamental principles of drug development in terms of preformulation study, compounding and dispensing of drugs, pharmaceutical calculation and excipients as well as pharmaceutical incompatibility study.
CLO2	Evaluate the quality attributes of product development such as particle size and the characterization of different types of disperse systems.
CLO3	Apply knowledge and skills of pharmaceutics to professional practice (e.g. basic compounding by pharmacists), and patient-centric product research and development/modification of pharmaceutical products.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓			✓		
CLO2	✓	✓	✓	✓	✓	✓		
CLO3	✓	✓	✓				✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Basic principles of compounding and dispensing: Weighing, measures and units, calculation for compounding and dispensing, fundamental operation in compounding, current good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription and ailing of dispensed medications.	3 hrs	CLO1 CLO3
2.	Pre-formulation: Preliminary evaluation and molecular optimization, bulk characterization of the material, crystallinity and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis, pKa determinations, pH solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability and solid state stability.	7.5 hrs	CLO1 CLO3
3.	Pharmaceutical excipients: Chemistry, physical properties and uses of the following excipients: acidifying agents, aerosol propellants, air displacement agents, alkalizing agents, anti-foaming agents, anti-microbial, preservatives, anti-oxidants, buffering agents, chelating agents, colors, complexing agents, desiccants, emulsifying agents, flavoring agents and perfumes, glidants, anti-caking agents, humectant, ointment bases, plasticizer, solvents, stiffening agents, tablet binders, tablet/capsule lubricants, tablet disintegrants, tonicity agent, water repelling agent, wetting and solubilizing agents.	10.5 hrs	CLO1 CLO3
4.	Disperse system: The colloidal state: Classification of colloids, properties of colloidal sols, electrical double layer, origin of the charge, stability of colloids, viscosity of colloids, coacervation, dialysis, properties of gels.	4.5 hrs	CLO2 CLO3

5.	Pharmaceutical calculation: Mathematical principles, common and decimal fractions, exponents and power and root, logarithmic calculations, reducing and enlarging formula, ratio and proportion, percentage calculations, ration strength, concentration measurement. Dose calculation, specific volume, specific gravity, specific density.	6 hrs	CLO1 CLO3
6.	Micromeritics: Importance of particle size determination, different means of expressing particles size, methods of particle size determination: optical and electron microscope studies, Coulter-counter methods, laser beam technique, sieve analysis, sedimentation methods, particle shape and surface area: measurement of particle surface area.	6 hrs	CLO2 CLO3
7.	Pharmaceutical incompatibility: Definitions, classification, causes of incompatibilities, different types of incompatibility, effect of incompatibilities and their method of correction.	4.5 hrs	CLO1 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Dispensing for Pharmaceutical Students- Cooper & Gunn
2. American Pharmacy- Sprowl.
3. Remington's Pharmaceutical Sciences-AR Gennaro
4. Dispensing of Medication- Husa & martin
5. Pharmaceutical Practice- Aulton
6. An introduction to Pharmaceutical Formulations- Fishburn
7. An introduction to Pharmaceutical Productions- Polderman
8. Pharmaceutical Calculations-Mitchell J. Stoklosa, Howard C. Ansel.
9. The Extra Pharmacopoeia- Martindale
10. Tutorial Pharmacy- Cooper & Gunn

Course Code	0222-001
Course Title	History of the Emergence of Bangladesh
Year & Semester	2nd Year 1st Semester
Course Credit	2
Credit Hours	28
Total Marks	80

Course Description:

History of the Emergence of Bangladesh is the study of the Bangladesh liberation war also known as Bangladesh war of independence and that was a revolution and armed conflict sparked by the rise of the Bengali nationalist and self-determination movement in what was then East Pakistan in 1971. The Course discusses about the struggling life of Bangabandhu Sheikh Mujibur Rahman and the others freedom fighter. The course also introduces about various self-righteous movements which happens during 1947-1971.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Develop their understanding of history of Bangladesh and its liberation war.
CLO2	Identify the major contemporary issues of liberation war and do research on it.
CLO3	Create patriotism among them and contribute to build a developed country.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓				✓		✓	✓
CLO2		✓			✓		✓	
CLO3					✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	A brief survey of socio-political condition of pre-partition India since 1905	2 hrs	CLO1 CLO2
2.	Partition of India in 1947	3 hrs	CLO1,CLO2
3.	Language movement	2 hrs	CLO1,CLO2 CLO3
4.	Political parties and political personalities.	3 hrs	CLO1,CLO2
5.	Disparity between two wings of Pakistan	3 hrs	CLO1,CLO2
6.	Military rule of Ayub Khan (1958-1969)	3 hrs	CLO1,CLO2
7.	The six-point movement	2 hrs	CLO1,CLO2 CLO3
8.	Mass upsurge of 1969 and fall of Ayub Khan	2 hrs	CLO1,CLO2
9.	Military rule of 1969 and Yehiya Khan	2 hrs	CLO1,CLO2
10.	General election of 1970	2 hrs	CLO1,CLO2
11.	The historic speech of 7 March by Bangabandhu Shaikh Mujibur Rahman and Non-cooperation movement	2 hrs	CLO1,CLO2 CLO3
12.	Genocide of 25 March, Mujibnagar government, the beginning of Liberation War and the emergence of Bangladesh	3 hrs	CLO1,CLO2 CLO3
13.	Surrender of arms by the 'Mukti Bahine' and withdrawal of Indian forces	1 hrs	CLO1,CLO2 CLO3
14.	Constitution of Bangladesh.	1 hrs	CLO1,CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. K.B. Sayeed, Political System of Pakistan.
২. সৈয়দ আনোয়ার হোসেন, বাংলাদেশের অভ্যুদয়ে পরাজিতের ভূমিকা
৩. ড. মো. মাহবুবুর রহমান, বাংলাদেশের ইতিহাস, ১৯৪৭-১৯৭১
৪. বশির আল হেলাল, ভাষা আন্দোলনের ইতিহাস
৫. আতিউর রহমান, মুক্তিযুদ্ধেও প্রস্তুতিপর্ব: অসহযোগের দিনগুলি
৬. অম্বুলেন্দু দে, স্বাধীন বঙ্গভূমি গঠনের প্রয়াস ও পরিণতি
৭. সিরাজুল ইসলাম (সম্পাদ.), বাংলাদেশের ইতিহাস, ১৭০৭-১৯৭১, ১ম, ২য় ও ৩য় খণ্ড
৮. আবুল মাল আব্দুল মুহিত, বাংলাদেশ: জাতিরাষ্ট্রের উদ্ভব

Course Code	0916-215
Course Title	Pharmaceutical Analysis-I Lab
Year & Semester	2nd Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

The course is designed to provide the student with basic information about practical analytical chemistry. This course introduces the equipment as well as the experimental techniques of quantitative analysis and helps the students to develop skills in their use. It is a practical picture of the theoretical course, exemplified by doing various experiments in acid base titrations in aqueous and non-aqueous solutions, precipitation titration, reduction oxidation titration and their applications.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the exploration of principles of quantitative analysis in aqueous, non-aqueous solutions, precipitation, complexation and redox reaction.
CLO2	Identify the different types of glassware and chemicals available in the analytical lab and their uses.
CLO3	Develop the knowledge to identify the different types of indicators available and the pH range at which they can be used.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓						✓
CLO2	✓	✓	✓				✓	✓
CLO3	✓	✓	✓					✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Assay of acetyl salicylic acid in aspirin tablets	4 hrs	CLO1,CLO2 CLO3
2.	Determination of potency of penicillin tablets	4 hrs	CLO1,CLO2
3.	Non- aqueous assay of phenobarbitone tablets	4 hrs	CLO1,CLO2 CLO3
4.	Assay of sodium bicarbonate	4 hrs	CLO1,CLO2 CLO3
5.	Assay of aluminum hydroxide gel	4 hrs	CLO1,CLO2 CLO3
6.	Assay of magnesium and aluminum from antacid preparation	4 hrs	CLO1 CLO3
7.	Determination of saponification value	4 hrs	CLO1 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture		10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Evaluation	15.5%		Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Quantitative Pharmaceutical Analysis (Vol I &II)-Chatten
2. A Textbook of Pharmaceutical Analysis – K. A. Connors
3. Quantitative Inorganic Analysis (Vol I & II)- Vogel
4. British Pharmacopoeia
5. United State Pharmacopoeia

Course Code	0916-216
Course Title	Pharmaceutical Microbiology Lab
Year & Semester	2nd Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course includes the culturing, examination, and identification of microorganisms including bacteria, fungi, yeasts, etc. The microbiology has a crucial role in effective infection prevention and control (IPC). This course mainly focuses on preparation of bacterial media, culture of bacteria, identification and characterization of bacteria, preparation of pure cultures and its identification etc.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate the preparation of bacterial media, culture, staining and count of bacteria and identification of bacteria or fungi.
CLO2	Analyze experimental results clearly and concisely, both verbally and in writing.
CLO3	Acquire knowledge and skill on the handling of various instruments like microscope, autoclave, hot air oven, laminar air flow, bacteriological incubator and colony counter with ensuring general precautions, safety measures and maintenance.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2		✓			✓			
CLO3		✓			✓	✓	✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Preparation of bacterial media	4 hrs	CLO1
2.	Culture of bacteria	4 hrs	CLO2
3.	Identification and characterization of bacteria	4 hrs	CLO1,CLO2 CLO3
4.	Preparation of pure cultures and its identification	4 hrs	CLO1,CLO2 CLO3
5.	Staining of bacterial cells and spores	4 hrs	CLO1,CLO2 CLO3
6.	Bacterial count	4 hrs	CLO1,CLO2 CLO3
7.	Identification and characterization of fungus	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Microbiology- Pelczar, Kreig and Chan
2. Microbiology: An Introduction- Tortora, Funkee and Case
3. Pharmaceutical Microbiology- Harris
4. Modern Medical Microbiology- M. R. Choudhury

Course Code	0916-217
Course Title	Physiology & Anatomy-II Lab
Year & Semester	2nd Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

It is a study of the structure and function of the human body including cells, tissues, and organs of the following systems: endocrine, cardiovascular, respiratory, digestive, urinary, and reproductive. Emphasis is on interrelationships among systems and regulation of physiological functions involved in maintaining homeostasis.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe and integrate knowledge about the functions and needs of the various tissues, organs, and organ systems, and explain how they relate to health and common pathologies and their pharmacological treatments in the context of disease, trauma, and exercise.
CLO2	Measure basic physiological parameters, perform basic analyses, and interpret the data, considering the limitations of the morphology on the conclusions that can be drawn.
CLO3	Integrate knowledge of skills in human physiology with other areas of science such as sport and exercise science, and paramedical courses.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓				✓		
CLO2		✓				✓		
CLO3	✓		✓					✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Differential count of RBC.	4 hrs	CLO1
2.	Differential count of WBC.	4 hrs	CLO1
3.	Demonstration of the effects of drugs on toad heart	4 hrs	CLO1
4.	Demonstration of the effects of electrolytes (Na ⁺ , K ⁺ , Ca ²⁺ etc.) on toad heart.	4 hrs	CLO1
5.	Recording of respiration by stethograph.	4 hrs	CLO1 CLO2 CLO3
6.	Recording Oxygen Level by Pulse Oximeter.	4 hrs	CLO1 CLO2 CLO3
7.	Estimation of blood sugar in normal person.	4 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Textbook of Medical Physiology- JE Hall, AC Guyton
2. Laboratory manual for Anatomy and Physiology: Connie Allen
3. Practical Book on Human Anatomy and Physiology:
Prof. Satish K. Mandlik

Course Code	0916-221
Course Title	Pharmaceutical Analysis –II
Year & Semester	2nd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course focuses on the principles, practical and analytical aspects of several types of chromatography and spectroscopy to solve experimental problems. This course helps students to know how to use chromatography as an analytical tool for establishing the components of a drug's formulation, enabling researchers to quantify the formulation and discover whether there are any impurities in a product. The course describes the application of different spectroscopic techniques to identify and quantify experimental samples and build the ability within the students to solve the structure related problems through interpretation of spectral data.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the fundamentals of radioactivity, natural and radioactivity, radioactive decay, different types of radiation, radiation detection and their measurements.
CLO2	Analyze and evaluate the interpretation of spectra, chromatograms, and effect of impurities on the quality and behavioral pattern of drugs as well as the quantitative & qualitative analysis of drugs using various analytical instruments.
CLO3	Develop basic practical skills using instrumentation techniques for structural determination and quality control.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓						
CLO2		✓		✓				✓
CLO3	✓	✓	✓	✓		✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Separation technique: a) Introduction, principles, procedures and theories of column chromatography and gel filtration techniques, thin layer chromatography, ion exchange chromatography methods of detection and applications. b) HPLC: Introduction, theory and principle, instrumentation, characteristics of stationary and mobile phases, reversed phase HPLC and application.	24 hrs	CLO1 CLO2 CLO3

2.	Instrumental methods of analysis: a) Polarimetry: Introduction, origin of optical rotation, molecular requirements for optical rotator power, methods used in polarimetry instruction and application. b) Fluorometry: Introduction, theory and principle of fluorescence, and chemical structure spectro-photometry, application, factors influencing intensity of fluorescence and application of fluorometry in pharmaceutical analysis.	9 hrs	CLO1,CLO2 CLO3
3.	Radiochemical methods of analysis: Fundamentals of radioactivity, natural and induced radioactivity, radioactive decay, different type of radiation, radiation detection and their measurement, principles of Geiger-Muller and Scintillation counter, radioactivation and isotope dilution analysis, characterization, methodology and use of radioisotope in pharmaceutical research.	9 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Pharmaceutical Chemistry (Vol I & II)- L.G. Chatten
2. A Textbook of Pharmaceutical Analysis– K. A. Connors
3. Quantitative Inorganic Analysis- A.J. Vogel, G Svehla
4. Quantitative Analysis – V.N. Alekseev
5. Elementary Organic Spectroscopy: Principles and Chemical Applications – Y.R. Sharma

Course Code	0916-222
Course Title	Medicinal Chemistry-I
Year & Semester	2nd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Medicinal Chemistry is the science that deals with the discovery or design of new therapeutic chemicals and their development into useful medicines. Medicinal Chemistry is pivotal in the design, synthesis and evaluation of new medicines. It is an interdisciplinary field of study combining aspects of organic chemistry, physical chemistry, pharmacology and medicines. This course describes the stereochemistry, mechanism of different type of reactions, basic structure of compounds, synthesis of new compounds, investigations of their relationships between the structure of natural or synthetic compounds and their biological activities.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Demonstrate the basic structure, properties and synthesis of natural or synthetic products and their uses.
CLO2	Describe the stereochemistry of different molecules and apply the knowledge in drug design.
CLO3	Relate the structure and physical properties of drugs to their pharmacological activity.
CLO4	Develop the knowledge in the overall process of drug discovery and apply them in product development in pharmaceutical industry as well as research laboratory.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓				✓			✓
CLO2	✓			✓				
CLO3	✓	✓		✓	✓			
CLO4	✓		✓					✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Stereochemistry: a. Geometrical isomerism of alkenes and cyclic compounds, cis-trans and (E), (Z) systems of nomenclature. b. Conformational isomers, conformation of open chain and cyclic compounds ⁻ c. Chirality of molecules, enantiomer, diastereomer, racemic modification, meso compounds, (R) and (S) configuration, sequence rule and optical rotation. d. Stereoselective and stereospecific reaction. e. Pharmaceutical importance of stereochemistry study.	13.5 hrs	CLO2
2.	Chemistry of Natural Products: a. Alkaloids: Occurrence, isolation, classification and properties of alkaloids. Structure determination, synthesis and physiological activities of ephedrine, nicotine, atropine and morphine. b. Terpenoids: Occurrence, isolation and classification. Synthesis of geraniol, citralionones and amyryn.	7.5 hrs	CLO1 CLO4
3.	Chemistry and structure activity relationship (SAR) of the following drugs: Sedative-hypnotics, anti-histamines, antibiotics and analgesics	13.5 hrs	CLO1 CLO3 CLO4
4.	Introduction to common essential drugs: Preparation and uses of salicylic acid, aspirin, paracetamol, benzoic acid, benzylbenzoate, sulfa-drugs, PABA, isoniazid, halothane, enflurane, methoxyflurane, etc.	7.5 hrs	CLO1 CLO4

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Organic Chemistry- Morrison and Boyd
3. Organic Chemistry (Vol I and II)- Finar
4. Feisers' Reagents for Organic Synthesis- Fieser
5. A Textbook of Medicinal Chemistry- Wilson and Gisvold
6. Medicinal Chemistry- Burger

Course Code	0541-223
Course Title	Mathematics and Statistics
Year & Semester	2nd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The basic mathematics and statistics course provide the fundamental knowledge and skills, and the basis for more advanced work later on. The core material is covered for developing the capacity to learn and apply mathematical and statistical ideas. It will also develop the capacity of students to formulate and analyze problems and to interpret scientific evidence using appropriate statistical methodology.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Develop the basic knowledge of mathematics and statistics.
CLO2	Analyze the mathematical and statistical literature of various types, including survey articles, scholarly books, and online sources.
CLO3	Apply the knowledge on mathematical and statistical thinking, training, and approach to problem solving, on a diverse variety of disciplines.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓					✓
CLO2	✓	✓	✓	✓				✓
CLO3		✓	✓	✓		✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	a) Function and Graph: Function and various types of functions, Sketch thegraph of different Functions , exponential and logarithmic curves. b) Differentiation: Rate of process, rules of differentiation, successive and partial differentiation, differentiation of a function. c) Integration: Rules of integration- integration as a summation, integration by partial fraction, graphical integration, find the area under a curve	18 hrs	CLO1 CLO2 CLO3
2.	Coordinate Geometry: Rectangular co-ordinates, determination of slope, intercept and points of intersection, changes of axes, First degree and second-degree equation, standard equation of circle, ellipse, parabola and hyperbola etc.	6 hrs	CLO1 CLO2 CLO3

3.	Matrix: Addition, subtraction and multiplication of matrices, unit matrix, row transformation (finding rank of matrix), determinants, inverse of a matrix, solutions of system of linear equations.	6 hrs	CLO1 CLO2 CLO3
4.	a) Introduction to statistics: Scope and application of statistics in pharmaceutical sciences. b) Collection, tabulation and graphical representation of data. c) Measures of central tendency: Arithmetic mean, geometric mean, harmonic mean, weighted mean, median and mode, this application in pharmacy. d) Measures of dispersion: Range, mean deviation, standard deviation, variation, coefficient of variation, and their application in pharmaceutical preparation. e) Probability: Laws of addition and multiplication.	12 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Calculus by Howard Anton (10th edition).
2. Matrix Analysis and Applied Linear Algebra - Carl D. Meyer.
3. Basic Concept of Probability and Statistics- J. L. Hodges, Jr. and E. L. Lehmann (2nd Edition)
4. College Linear Algebra- Professor Md. Abdur Rahman
5. Differential and Integral Calculus- Das and Mukherjee.
6. Statistics and Probability- M. Nurul Islam

Course Code	0916-224
Course Title	Pharmacology-I
Year & Semester	2nd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmacology is the study on drugs, how a drug affects a biological system and how the body responds to the drug. The discipline encompasses the sources, chemical properties, biological effects and therapeutic uses of drugs. General Pharmacology consists of two fields of interest, pharmacokinetics and pharmacodynamics. The most important concept in pharmacodynamics is the dose-response relationship, which describes the dependence of the effect of a drug from its concentration at its receptor.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the branches of pharmacology, sources of drugs and different routes of drug administration, difference between drug and dosage form, the mechanism of drug action.
CLO2	Evaluate the indication, adverse effects and contraindication of drugs.
CLO3	Analyze the existing medicine and researching substances, chemicals and compounds for the production of new drug treatments.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓	✓			✓
CLO2	✓	✓		✓	✓			
CLO3		✓	✓	✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	General Pharmacology: Methods of drug administration, half-life, drug absorption, bioavailability, distribution of drugs, protein binding, accumulation and storage in body, drug dilution in the body fluid, metabolism of drugs and excretion. Drug allergy, idiosyncrasy, drug toxicity and drug interaction.	6 hrs	CLO1 CLO3
2.	Mechanism of drug action: a) Basic concept of drug action. b) Physico-chemical nature of drugs c) Drug receptors d) Binding forces in drug-receptor interaction e) Receptor and non-receptor mechanisms of drugs f) Macromolecular nature of drug receptors g) Relationship between drug concentrations versus response: Concentration-effect curve and receptor binding of agonists, competitive and irreversible antagonism, partial agonists, receptor-effectors coupling and spare receptors, other mechanisms of drug antagonism.	10.5 hrs	CLO1 CLO3
3.	Chemotherapeutic agents: Introduction, classification, chemistry, mode of action, structure-activity relationship, pharmacokinetics, indications, contra indications. Dose, adverse effects and drug interactions of the following individual class of drugs: i) Sulfonamides ii) Penicillins and Cephalosporins iii) Tetracyclins, Chloramphenicol, Aminoglycosides and Macrolides iv) Anti-fungal agents, v) Anti-tubercular drug vi) Antileprosy drugs vii) Miscellaneous antibacterial agents: a) Glycopeptide antibiotics (b) Polymixin antibiotics (c) Bacitracin (d) Nitrofurantoin viii) Antiviral drug including HIV.	10.5 hrs	CLO1 CLO2 CLO3

4.	Drugs action on GIT: (Antacids): General consideration, chemistry, absorption, modification distribution and excretion. Action and adverse effects of gastric antacids. Classification of antacid-aluminium hydroxide, aluminum carbonate, calcium carbonate, magnesium hydroxide and oxide, magnesium carbonate, megaldrate, magnesium trisilicate, sodium bicarbonate, antacid mixtures, colloidal bismuth, H ₂ receptor antagonists, (cimetidine, ranitidine and famotidine), proton pump inhibitor, anti emetics, anti-diarrhoeal agents and laxatives.	6 hrs	CLO1 CLO2 CLO3
5.	Autacoids: a) Histamines: Mode of action, action on cardiovascular system, smooth muscle, gastric secretion, anaphylactic shock, histamine-releasing drugs, allergic disorder. b) Antihistamines: Classification, pharmacological, therapeutic uses absorption, distributions, excretion adverse reactions etc. c) Serotonin and serotonin antagonists: Occurrence, pharmacological action, serotonin antagonist, prostaglandins, prostacyclins and thromboxanes. d) Prostaglandins	6 hrs	CLO1 CLO2 CLO3
6.	Drugs used in haemopoietic system: (a) Anticoagulants: Heparin, warfarin, dicumarol, Na and K-oxalates and citrates. (b) Iron, folic acid and vitamin B12 (Hematinics).	3 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)					
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
	Class test/ Quiz/Viva/ Case study	10%							
	Assignment/ Presentation	5%							
	Midterm Exam	30%							
	Final Exam	50%							
	Total	100%							

Learning References:

1. Pharmacological Basis of Therapy- Goodman & Gillman
2. Medical Pharmacology- Meyer
3. Medical Pharmacology- Goth
4. Pharmacology and Pharmacotherapeutics- R. S. Satosker
5. Lippincott's Illustrated Reviews on Pharmacology – Richard A. Harvey, Pamela C. Champe.

Course Code	0916-225
Course Title	Clinical Pathology
Year & Semester	2nd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Clinical Pathology study aims to develop student's knowledge on disease and medical laboratory sciences. This encompasses pathogenesis of a variety of common and uncommon diseases that lead to sign and symptoms that must be recognized in patients, diagnosis of disease, identification of cause or severity of disease and monitoring disease progression and management of diseases.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Explain the basic nature of disease processes from the standpoint of causation, and the structural and functional abnormalities that result.
CLO2	Describe the diseases of various body systems and how they manifest clinically and histopathologically.
CLO3	Identify the diseases from clinical scenarios by recognizing key manifestations of congenital, cardiovascular, respiratory, hemodynamic, inflammatory, infectious, metabolic and neoplastic diseases.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2	✓		✓					
CLO3	✓	✓						✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: General pathology, core and scope of pathology, general concept of diseases.	1.5 hrs	CLO1,CLO2 CLO3
2.	Cellular response: Homeostasis; Cellular responses to injurious stimulus; cellular injury, morphology of injured cells, mechanism of cell injury; Cell death, apoptosis and necrosis; Intracellular accumulation, fatty changes, pathologic calcification; Various degree of damages associated with cell death and the diagnostic method used to evaluate the consequences of cell death; cellular adaptation; cellular aging.	6 hrs	CLO1 CLO2 CLO3
3.	Inflammation and tissue repair: Inflammation, mediators of inflammation, morphological patterns of acute inflammation, events of acute inflammation, phagocytosis, cells involved in chronic inflammation, granulomatous inflammation, systemic effects of inflammation; Tissue repair, mechanism of repair, factors affecting wound healing, wound healing by primary and secondary intention.	4.5 hrs	CLO1 CLO2 CLO3
4.	Neoplasia: Tumor, tumor markers, oncogenes, genesis of cancer cell, molecular basis of cancer, biology of tumor growth, carcinogen and their cellular interaction, grading and stages of cancer, laboratory diagnosis of cancer.	4.5 hrs	CLO1 CLO2 CLO3
5.	Infectious Diseases: Herpes simplex, diphtheria, tuberculosis, syphilis, plague, tetanus, filariasis, COVID-19.	3 hrs	CLO1,CLO2 CLO3
6.	Nutritional diseases: Malnutrition, marasmus, kwashiorkor, and deficiency states of different types of vitamins and minerals.	1.5 hrs	CLO1,CLO2 CLO3
7.	Cardiovascular diseases: a) Hemodynamic disorders: Edema, hyperemia, congestion, thrombosis, haemorrhage, embolism, infarction, shock. b) Diseases of blood vessels: Arteriosclerosis and atherosclerosis, hypersensitivity, thrombophlebitis, vasculitis. c) Heart disease: Risk factors of cardiovascular diseases, etiology, pathogenesis and diagnosis of angina pectoris, congestive heart failure, heart block, myocardial infarction, congenital heart disease, stroke, ischemic heart disease.	7.5 hrs	CLO1 CLO2 CLO3

8.	Gastrointestinal diseases: Etiology, pathogenesis, diagnosis, clinical presentation and complication of peptic ulcer disease, inflammatory bowel disease, GI bleeding, appendicitis, gastric carcinoma.	3 hrs	CLO1 CLO2 CLO3
9.	Hepatic diseases: Purpose and type of liver function test, etiology, pathogenesis, clinical presentation and biochemical characteristics of liver cirrhosis, hepatitis, jaundice, hepatic tumors, drug and alcohol induced liver toxicities and prevention.	3 hrs	CLO1 CLO2 CLO3
10.	Respiratory diseases: Etiology, pathogenesis, diagnosis, complications, and clinical presentation of respiratory diseases; COPD, asthma, influenza, pneumonia, respiratory failure, atelectasis, pulmonary tuberculosis, pulmonary hypertension, bronchogenic carcinoma.	4.5 hrs	CLO1 CLO2 CLO3
11.	Renal diseases: Etiology, pathogenesis, clinical presentation and biochemical characteristics of acute and chronic renal insufficiency, kidney tumors, renal stones, drug-induced renal toxicity.	3 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Practical Pathology and Microbiology- Prof. K. A. Khaleque, Dr. K. Z. Mamun
2. Pathological Basis of Diseases – Robbins.
3. Endeavour Pathology and Haematology – Dr. JahirUddin Mohammed Sharif.

Course Code	0916-226
Course Title	Pharmaceutical Analysis-II Lab
Year & Semester	2nd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmaceutical Analysis is a branch of practical chemistry that involves a series of processes for identification, determination, quantification and purification of a substance, separation of the components of a solution or mixture, or determination of structure of chemical compounds. The course includes drug analysis using spectrophotometric and titrimetric methods. This course also focuses on microbiological assay method for measuring compounds such as vitamins and antibiotics, using micro-organisms.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Recall and relate the principle of spectroscopy, chromatography and other commonly used instrumental methods of analysis.
CLO2	Plan and select lab experiments using appropriate analytical skills and generate a comprehensive analytical report on the findings.
CLO3	Develop skill of operation, calibration and inference of results of instruments such as pH meter, UV-visible spectrophotometer and also construct documentation and interpretation of analytical data.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓				
CLO2	✓	✓	✓			✓		
CLO3	✓			✓	✓	✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Pharmaceutical analysis of drugs using spectrophotometer.	4 hrs	CLO1 CLO2 CLO3
2.	Extraction and Thin layer chromatography of plant part (leaf)	4 hrs	CLO1 CLO2 CLO3
3.	Extraction and Thin layer chromatography of plant part (flower)	4 hrs	CLO1 CLO2 CLO3
4.	Determination of iodine values of fixed oils.	4 hrs	CLO1,CLO3
5.	Assay of milk of magnesia suspension.	4 hrs	CLO1,CLO2
6.	Assay of milk of magnesia emulsion.	4 hrs	CLO1,CLO3
7.	Microbiological assay of vitamin & antibiotics.	4 hrs	CLO1,CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Quantitative Pharmaceutical Analysis (Vol I &II)-Chatten
2. Elementary Organic Spectroscopy – S. Chand and Y. R. Sharma

Course Code	0916-227
Course Title	Medicinal Chemistry-I Lab
Year & Semester	2nd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Medicinal chemistry laboratory introduces various quality control methodologies that are considered standards in pharmaceutical literature. Analysis of raw material as well as different formulated preparations will be performed using standard analytical techniques.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the difference between brand, trade and generic name of drugs
CLO2	Demonstrate verbally the depth of understanding, thinking and problem solving ability
CLO3	Develop skills for the synthesis of medicinal compounds and qualitative and quantitative measurement

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓	✓	✓		✓
CLO2	✓		✓	✓	✓			✓
CLO3	✓	✓	✓	✓	✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Synthesis of Acetyl p- aminophenol (Paracetamol).	4 hrs	CLO1,CLO2 CLO3
2.	Synthesis of Acetyl salicylic acid (Aspirin)	4 hrs	CLO1,CLO2 CLO3
3.	Synthesis of Benzocaine	4 hrs	CLO1,CLO2 CLO3

4.	Synthesis of Phenacetin	4 hrs	CLO1,CLO2 CLO3
5.	Synthesis of PABA (Para amino-benzoic acid)	4 hrs	CLO1,CLO2 CLO3
6.	Synthesis of Para-aminophenol	4 hrs	CLO1,CLO2 CLO3
7.	Synthesis of Methyl salicylate	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Organic Chemistry- Morrison and Boyd
3. Organic Chemistry (Vol I and II)- Finar
4. Feisers' Reagents for Organic Synthesis- Fieser
5. A Textbook of Medicinal Chemistry- Wilson and Gisvold
6. Medicinal Chemistry- Burger

Course Code	0916-228
Course Title	Pharmacology-I Lab
Year & Semester	2nd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course is the introduction to pharmacology laboratory. The aim of the experiments is to measure the different biochemical parameters of living organisms. Moreover, students can learn about experimental animal handling process along with route of the drug administration.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Demonstrate the blood glucose level estimation and importance of glucose in metabolic pathway.
CLO2	Analyze the concentration of protein in an unknown sample.
CLO3	Measure a biochemical product uric acid in blood sample.
CLO4	Apply the knowledge of animal handling and use small mammal to investigate the actions of various pharmacological agents in research.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓				✓	✓		
CLO2		✓	✓	✓	✓			
CLO3	✓	✓		✓	✓			
CLO4	✓				✓			✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Estimation of blood glucose by chemical method	4 hrs	CLO1
2.	Estimation of plasma protein by Lowry method	4 hrs	CLO2
3.	Estimation of blood uric acid level	4 hrs	CLO3
4.	Estimation of urine glucose by enzyme strip & Benedict method	4 hrs	CLO3
5.	Handling of experimental animals: mice and rat	4 hrs	CLO4
6.	Study of different routes of administration of drugs in experimental animals	4 hrs	CLO4
7.	Clotting time and bleeding time (capillary/Lee-White) - simple coagulation practical	4 hrs	CLO1

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Handbook of Experimental Pharmacology- Shivsharan B. Dhadde
2. Handbook on Laboratory Animals - PV Desai & P Saravanan
3. Pharmacological Basis of Therapeutics- Goodman & Gillman

Course Code	0916-229
Course Title	Oral Assessment-II
Year & Semester	2nd Year 2nd Semester
Course Credit	1
Credit Hours	15
Total Marks	100

Course Description:

Viva voce is a Latin phrase literally meaning "with living voice" but most often translated as "by word of mouth". It may refer to an oral examination. The oral exam (also oral test or viva voce) is a practice in many disciplines in which an examiner poses questions to the student in spoken form. The student has to answer the question in such a way as to demonstrate sufficient knowledge of the subject to pass the exam.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate the vocal depth of comprehension, critical thinking and problem-solving skills.
CLO2	Interact with courage and spontaneity beyond nervousness in face-to-face interview.
CLO3	Present their concepts orally in a methodical manner and demonstrate preparedness for a future job interview.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓			✓	✓	✓
CLO2	✓		✓		✓	✓	✓	✓
CLO3	✓		✓			✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	All courses of 2nd Year 2nd Semester	15 hrs	CLO1,CLO2 CLO3

Teaching- Learning Approach	Assessment Strategy		Positive Reinforcement Tasks
Discussion of lecture Overview of courses Question-Answer session Text books PowerPoint lecture notes Websites Videos/Documentaries Scientific articles	Attendance	10 %	Feedback/Response Individual discussion Group discussion Misconception check Summarization of lecture
	Viva (Attire, Attitude, Speaking, Knowledge)	90 %	
	Total	100%	

Learning References:

1. All textbooks of this semester

Course Code	0916-311
Course Title	Pharmaceutical Analysis-III
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The course provides specialized knowledge of the analytical techniques used to detect, identify, and quantitatively determine drugs and related substances. Students will be introduced to techniques for evaluating analytical data and validating analytical methods and examine strategies for analytical research and development.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the principles of volumetric and electro chemical analysis, the sources of impurities, methods to determine the impurities in inorganic drugs and pharmaceuticals, and the benefits of advanced instruments in comparison with other conventional methods.
CLO2	Demonstrate various volumetric and electrochemical titrations and become proficient in advanced instruments.
CLO3	Develop analytical skills

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓				✓
CLO2	✓		✓					✓
CLO3	✓			✓	✓	✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Conductometry: Principle, apparatus and measurements, experimental details of conductometric titration, conductometric titration curve, applications and Kohl-rausch's Law.	9 hrs	CLO1 CLO2

2.	Potentiometry: Principle, methods, and applications.	6 hrs	CLO3
3.	Amperometry: Theory and technique of amperometric titration with dropping mercury electrode, amperometric titration curve, applications, and factor affecting current flow during analysis.	6 hrs	CLO1 CLO2 CLO3
4.	Polarography: Principle, component of polarogram, Ilkovic equation, diffusion current, factors affecting diffusion current and half wave potential, quantitative analysis, polarographic maxima suppressor, oxygen wave, supporting electrolyte and applications.	9 hrs	CLO1 CLO2 CLO3
5.	X-ray crystallography: X-ray and diffraction of X-ray, Bragg's law, powder diffraction patterns, methods of measurement, analysis, and application of X-ray diffraction.	6 hrs	CLO1 CLO2 CLO3
6.	Bioassay: Prerequisites and development, errors in bioassay, overcome method, statistical design of bioassay, method, and determination of bioavailability.	6 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%			10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Quantitative Pharmaceutical Analysis (vol I & II) - Chatten
2. A Textbook of Pharmaceutical Analysis - K. A. Connors
3. Quantitative Inorganic Analysis (vol I & II) - Vogel
4. British Pharmacopoeia
5. United State Pharmacopoeia.

Course Code	0916-312
Course Title	Medicinal Chemistry-II
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Medicinal Chemistry is helpful in recognizing the relation between molecules for design of certain synthetic leads. The categories of drug classes and their efficacies including antibiotics, antibacterial, antiviral, antifungal, anthelmintic, anticancer, steroids and hormones will be identified.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the possible binding mode and affinity of drug molecules to biological target.
CLO2	Develop critical thinking and problem-solving ability of medicinal products.
CLO3	Evaluate knowledge about drug chemical structure and metabolism of drug molecules.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2			✓			✓		✓
CLO3	✓			✓				

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Principle of drug design: Theory, different traditional and mechanism-based approaches to drug design, application of quantum mechanics, molecular modeling, quantitative structure-activity relationship (QSAR), congeneric series and clinical evaluation.	4.5 hrs	CLO1
2.	Computer aided drug designing (CADD): Introduction, molecular and quantum mechanics, drawing chemical structures, 3D structures, energy minimization, viewing 3D molecules, molecular dimensions, molecular properties, conformational analysis, identifying the active conformation, 3D pharmacophore identification, docking procedures, automated screening of databases for lead compound, protein mapping, denovo synthesis, planning a combinatorial synthesis, database handling.	6 hrs	CLO1 CLO2
3.	Molecular mechanism of drug action: Signaling mechanisms and drug action: Regulation of gene expression by intracellular receptors, ligand regulated transmembrane enzymes, ligand gated channels, G-proteins and secondary messengers, such as cyclic-AMP, calcium and phosphoinositides and cyclic-GMP interplay among signaling mechanisms.	13.5 hrs	CLO1 CLO2
4.	Drug metabolism: Various pathway of drug metabolism, metabolism of various group of drugs, factors affecting drug metabolism with special emphasis on aging, methods of studying drug metabolism, new aspects of drug metabolism.	6 hrs	CLO3
5.	Combinatorial chemistry: a) Combinatorial synthesis: Introduction to drug discovery process b) Library synthesis on resin beads- solid phase chemistry, resin beads, speeding up of peptide synthesis, mix and split library synthesis c) Solution phase, indexed combinatorial and template-based libraries, liquid phase combinatorial synthesis, d) Encoded combinatorial synthesis-encoded requirements. examples of tagged libraries e) Solid phase library, chemistry of linkers, carboxylic acid linkers, carboxamide linkers, alcohol linkers, amine linkers, traceless linkers, light cleavable linkers, selected solid phase chemistry, f) Analysis of products with different analytical techniques used, IR, solid phase NMR	12 hrs	CLO1 CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Organic Chemistry- Morrison and Boyd
3. Organic Chemistry (Vol I and II)- Finar
4. Feisers' Reagents for Organic Synthesis- Fieser
5. A Textbook of Medicinal Chemistry- Wilson and Gisvold
6. Medicinal Chemistry- Burger

Course Code	0916-313
Course Title	Pharmacology-II
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course describes the basic scientific concepts and principles that serve as the foundational underpinnings of the pharmacological sciences including pharmacokinetics, pharmacodynamics, drug metabolism, and drug-drug interactions, and explains how these fundamental pharmacological properties can influence route of administration, drug action, drug efficacy and potency, drug levels in the body, potential for drug interactions, drug toxicity, and the appropriate choice of drug for pharmacotherapy in a patient.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the pharmacological agents with advance in biomedical science and evolving concepts of acceptable medical practices.
CLO2	Develop the knowledge of the clinical applications, side effects and toxicities of drugs used in medicine such as cardiovascular drugs, narcotic and non-narcotic drug, CNS depressant and CNS stimulant.
CLO3	Identify a range of drugs used in medicine and discuss their mechanisms of action, drug receptor interaction and specific drug class for psychological disorder and distinguish between local and general anesthetics.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2		✓	✓					✓
CLO3	✓							✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Cardiovascular drugs: a. Introduction, classification, chemistry, mode of action, structure activity relationship, pharmacokinetics, indications, contra indications, dose, adverse effects and drug interactions of the following individual class of drugs: a) Digitalis and allied drugs b) Antihypertensive drugs: (i) ARB drugs (ii) ACE inhibitors (iii) β -blockers, propranolol etc. (iv) α -blockers, prazosin etc (v) Vasodilators. b. Antiarrhythmic drugs: Na^+ , K^+ , Ca^{2+} -channel blockers quinidine, procaine amide. c. Antianginal drugs: Organic nitrates; Nitroglycerin	10.5 hrs	CLO1 CLO2 CLO3
2.	Drugs acting on renal system: Diuretic; Carbonic anhydrase inhibitors, thiazide diuretics, low and high ceiling diuretics, potassium sparing diuretics and osmotic diuretics.	3 hrs	CLO1 CLO2 CLO3

3.	Drugs acting on CNS a) Analgesic and antipyretics. (i) Non opoids (NSAID): Salicylates and congeners. (ii) Opioids: Natural and synthetic. b) Sedative-hypnotics: Benzodiazepines, barbiturates etc. CNS stimulants: Amphetamine, caffeine, strychnine, xanthine derivatives.	9 hrs	CLO1 CLO2 CLO3
4.	Psychotropic drugs: Classification, mode of action, pharmacological actions, indications, toxicities and contraindications of chlorpromazine, benzodiazepam, TCA, MAO inhibitors, SSRIs (fluoxetine) etc.	4.5 hrs	CLO1 CLO2 CLO3
5.	Drug acting on ANS a) Parasympathomimetic agents: Acetylcholine, methacoline, carbachol. b) Sympathomimetic agents: Epinephrine, norepinephrine. c) Anticholinesterase agents: Physostigmine, d) edrophonium, organophosphorous compounds. e) Antimuscarinic agents or atropine drugs: Atropine sulfate, scopolamine hydrobromide, homatropine hydrobromide. f) Drugs inhibiting adrenergic nerves and structures innervated by them, adrenergic blocking agents. g) Neuromuscular blocking agents.	9 hrs	CLO1 CLO2 CLO3
6.	Anesthetics: Introduction and classification a) Local anesthetics: General properties, chemistry and mechanism of action, pharmacological action, clinical use and adverse effect of cocaine, procaine, benzocaine, lidocaine, bupivacaine etc. b) General anesthetics: (i) Inhalation anesthetics: Halothane enflurane, methoxyflurane, nitrous oxide, diethyl ether, cyclopropane, and ethylene etc. (ii) Intravenous anesthetics: Barbiturates, opioids, etc.	6 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Pharmacology-Lippincott's illustrated review
2. Pharmacological Basis of Therapy- Goodman & Gillman
3. Medical Pharmacology- Meyer
4. Medical Pharmacology- Goth
5. Pharmacology and Pharmacotherapeutics- R. S. Satosker
6. Essential Pharmacology- K D Tripathy
7. Basic and Clinical Pharmacology- B G Katzung
8. Apex Medical Pharmacology-Dr. Javed Yousuf.

Course Code	0916-314
Course Title	Pharmaceutical Technology-I
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

The Pharmaceutical Technology-I is designed to introduce the principles, preparation and control of liquid dosage forms, dispersed system, semisolids, and suppositories with particular reference to solid and liquid ones administered by the oral route. The course also provides students with the necessary knowledge to understand the relationships between the dosage form in which the active ingredient is formulated and their quality control, physico-technological characteristics as well as route of administration. The legislation concerning the ability of the pharmaceutical dosage form to maintain the physical, chemical, therapeutic, and microbial properties during the time of storage, packaging materials, and usage by the patient are also addressed.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Explain the physicochemical principles, formulation processes, and manufacturing considerations of various pharmaceutical dosage forms, including liquid, dispersed, semisolid, and suppository preparations.
CLO2	Analyze factors affecting the stability, preservation, and quality control of pharmaceutical products, including drug decomposition processes, stability testing under different climatic zones, and strategies for ensuring product quality during packaging and storage.
CLO3	Evaluate pharmaceutical packaging materials and formats in terms of their physical properties, suitability for different dosage forms, and their role in protecting product stability and ensuring patient safety.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓				
CLO2	✓	✓		✓	✓		✓	✓
CLO3	✓			✓	✓			✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Liquid dosage forms: Solution and elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation and manufacturing considerations, packaging of liquids, preservation and stability aspects and quality control systems of liquids.	4.5 hrs	CLO1 CLO2
2.	Dispersed system I. Properties of dispersed systems: Theoretical aspects of suspension, emulsion and colloids, surface characteristics and zeta potential, inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence. II. Suspension: Definition and application, advantage and disadvantages, aggregated and dispersed system, formulation, manufacturing and stability, evaluation, rheological consideration, illustrative examples.	12 hrs	CLO1 CLO2

	III. Emulsion: Definitions and applications, advantage and disadvantages, theory of emulsion, formation of emulsion, classification of emulsifying agents, HLB values of surface active agents, formulation manufacturing, stability and evaluation, rheological considerations.		
3.	Semisolids (ointments, paste, gels, etc.): Structure of skin, percutaneous absorption of drugs, definition and classification of semisolid, classification of ointment bases, formulation and manufacturing, rheological considerations, evaluation and quality analysis.	4.5 hrs	CLO1 CLO2
4.	Suppositories: Definition, advantages & disadvantages, Classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, displacement value of testing of suppositories, mechanism of absorption of medicaments from suppositories.	9 hrs	CLO1 CLO2
5.	Drug decomposition: Decomposition of drugs and pharmaceutical product, stability study, climatic zones for stability study, stress testing, long term, intermediate and accelerated stability testing.	7.5 hrs	CLO1 CLO2
6.	Pharmaceutical Packaging: I) Introduction: Packaging, classification of packaging, packaging essential requirements, functions of packaging, importance of pharmaceutical packaging, the main packaging materials, properties of ideal packaging materials, packaging formats in pharmaceutical industry. Classification of packaging and packaging materials, blister packaging, foil packaging, ancillary materials used in packaging (adhesives, paper, paper-board, leaflets, package insert, package ousters, fiber-board, jute, wood). II) Types of Packaging materials for pharmaceutical products: a) Polymers and plastics: Plastics, the structure of polymers, raw materials of plastics, types of plastics, resin identification code, availability of recycling facilities, plastics and packaging. b) Glass: Selection of glass as packaging materials for the pharmaceutical products, properties of glass, production of glass, types of glass, other types of glass, factors other than usp type, manufacturing of glass containers, features of glass containers, test for glass containers, advantages and disadvantages of glass containers, uses of glass containers. c) Metals in packaging: Introduction, aluminium, aluminium foil, collapsible tubes, tin, lead, stainless steel	4.5 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Dispensing for Pharmaceutical Students- Cooper & Gunn
2. American Pharmacy- Sprowl
3. Remington's Pharmaceutical Sciences- AR Gennaro
4. Dispensing of Medication- Husa& Martin
5. Pharmaceutical Practice- Aulton
6. An introduction to Pharmaceutical Formulations- Fishburn
7. An introduction to Pharmaceutical Productions- Polderman
8. The Extra Pharmacopoeia- Martindale
9. Bentley's Textbook of Pharmaceutics- Arthur Owen Bentley
10. Tutorial Pharmacy- Cooper & Gunn
11. Theory and Practice of Industrial Pharmacy- Lachman
12. Lachman, Lieberman, King; The Theory and Practice of Industrial Pharmacy
13. N K Jain; Pharmaceutical Arithmetic
14. A Handbook of Pharmaceutical Excipients

Course Code	0916-315
Course Title	Pharmaceutical Engineering
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical engineering is a branch of engineering focused on discovering, quality control processes of equipments, and on designing the building, and improving manufacturing sites that produce drugs. One of the most important distinctions between pharmaceutical engineering and other branches of engineering is the pharmaceutical industry's strict requirements for GMP. The topics and contents are designed to satisfy for utilizing the fields of pharmaceutical sciences correlating with industrial engineering.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe the principle, construction, working, uses, advantages and disadvantages of pharmaceutical equipment's used for various unit operations.
CLO2	Demonstrate various laws, material handling techniques in manufacturing process.
CLO3	Analyze a comprehensive process flow diagram for a pharmaceutical process.
CLO4	Explain the various preventive methods used for corrosion control in pharmaceutical industries.
CLO5	Apply academic knowledge to the solution of a real-life research.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2	✓	✓						
CLO3	✓			✓				
CLO4	✓			✓				
CLO5						✓	✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Drying: Definition, importance of drying, terminology, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content, classification: direct, indirect, radiation, dielectric, batch and continuous, dryers, types of beds: static, moving, fluidized, pneumatic bed systems, different drying equipment's (construction, operation, merits, demerits): tray dryer, through-circulation dryer, pneumatic conveying dryer, rotary dryer, spray dryer, tunnel dryer, steam tube rotary dryer, agitated pan dryer, vacuum rotary dryer and freeze dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection.	7 hrs	CLO1 CLO3

2.	Mixing: a) Solid-solid mixing: Importance, fundamentals, batch homogeneity, types of solids-mixing machines: (mixing mechanisms and operations) double cone, twin shell, horizontal drum, double-cone revolving around long axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor, performance, characteristics, selection of machines. b) Paste mixing: definition, importance, simple blending, dispersion operations and general equipment design. Standard types of equipment and operations, change-can mixer, change-can mixer with planetary motion, change-can mixer with rotating turntable, troy angular mixer, duplex mixer, stationary -tank mixer, kneader, mullers, three-roll mill, selection of process and mixer. c) Liquid mixing: Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, flat-blade and curved blade turbines, spiral turbines, paddles, gate impellers, anchor impellers, different fixed-mounted and portable positions, shaft lengths, baffled and unbaffled tanks, vortex formation and its control, selection of impeller.	10.5 hrs	CLO1 CLO5
3.	Filtration: Definition, importance of filtration, difference with expression, sedimentation and drying, classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment: (construction, operation, merits and demerits) the gravity nutsche, Delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, Eimco-Burwell plates and frames, Readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney Hunt pressure filter, Moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipment.	7 hrs	CLO1 CLO2
4.	Centrifugation: General principles, magnitude of centrifugal force, materials of construction, critical speed, sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.	3.5 hrs	CLO1 CLO2
5.	Milling: Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process, methods of size reduction by cutter mill, roller mill, hammer mill, ball mill, vibration mill, edge runner mill, end runner mill, fluid energy mill, hand mill, colloid mill (principle, design, operation and advantages) and selection of a mill.	3.5 hrs	CLO1 CLO5

6.	Air conditioning, refrigeration & humidity control a) Air conditioning: Definition, importance, pharmaceutical application, differences between air conditioner & air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air-conditioned room, pharmaceuticals needing air conditioning, heating, ventilation, and air conditioning (HVAC) systems and its importance. b) Refrigeration: Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage. c) Humidity control: Terminology (psychrometry, absolute humidity, relative humidity, psychometric charts), measurement of humidity, applications of humidity control, effect of humidity in human body and role of humidity control in pharmaceutical industry.	7 hrs	CLO3 CLO4 CLO5
7.	Water treatment plant in pharmaceutical industry: Source of raw water, Natural impurities in raw water and their removal, Purification methods, Definition, and classification of pharmaceutical water. Manufacturing and storage of pharmaceutical water, Distillation of water, Ion-exchange process, Reverse osmosis, microbiological quality, and analysis of pharmaceutical water.	3.5 hrs	CLO3 CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Theory and Practice of Industrial Pharmacy- Lachman
2. Tutorial Pharmacy- Cooper & Gunn.
3. Remington's Pharmaceutical Sciences.
4. American Pharmacy- Sprowl
5. Dispensing of Medication- Husa & Martin.
6. Pharmaceutical Practice-Aulton
7. An Introduction to Pharmaceutical Formulations-Fishburn
8. An Introduction to Pharmaceutical productions- Polderman
9. The Extra Pharmacopoeia- Martindale
10. Bentley's Textbook of Pharmaceutics
11. Dispensing for Pharmaceutical Students- Cooper & Gunn.

Course Code	0916-316
Course Title	Applied Pharmaceutical Microbiology
Year & Semester	3rd Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Applied Pharmaceutical Microbiology provides knowledge and understanding with regards to the significance of the presence of bacteria, yeasts, moulds, viruses and toxins in pharmaceutical raw materials, intermediates, products and pharmaceutical production environments, as well as the microbiological control of pharmaceutical products, production environments and people. It also incorporates the study of microorganisms that are pertinent to the production of antibiotics, enzymes, vitamins, vaccines, and other pharmaceutical products.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the concept of sterilization processes and apply them in sterilization of different things in pharmaceuticals.
CLO2	Identify the pathogens by standard techniques and methods of culturing, preservation and maintenance of microorganisms as well as expand the knowledge regarding bacterial resistance.
CLO3	Evaluate different methods of microbial monitoring systems for environment and pharmaceutical product in pharmaceutical industry.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1			✓		✓			✓
CLO2	✓	✓						✓
CLO3				✓				

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Sterilization by dry heat: Principle, hot air oven, method of use, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heat, principle of sterilization by steam under pressure, Autoclave- applications, testing the efficiency of autoclaves, sterilization by heating with bactericides, validation of sterilizers. Sterilization by filtration, Sterilization by radiation, Sterilization by gas.	6 hrs	CLO1
2.	Sterility testing: Sampling techniques. Types of media used in sterility testing. Positive and negative controls. Bacterial endotoxin test, LAL test, Liquid born particulate test. Testing procedure for aqueous solutions, aqueous suspensions, powders, semi-solid preparations, oils and ointments, ligatures and sutures, surgical dressings, equipments. Miscellaneous tests: Immunological preparations and viral products	6 hrs	CLO1 CLO4
3.	Disinfection and antisepsis: Introduction to disinfection, Factors influencing disinfection, Chemical disinfectants, and their modes of action, Disinfectant evaluation.	6 hrs	CLO2 CLO3
4.	Microbial assay of antibiotics: Antimicrobial activity. Factors affecting the measurement of antimicrobial activity. Antibiotic assays. Biological and non-biological assays. Determinations of MICs (Minimum Inhibitory Concentrations). Challenge tests. Microbiological quality of pharmaceutical materials with special reference to Non-sterile and Sterile products, t- Test.	9 hrs	CLO2 CLO5

5.	Industrial microbiology: Microbial examination of raw materials, Detection and measuring the penicillin contamination in drug and equipment, Identification of bacteria by gram staining method, Microbiological monitoring of water, Cleaning and sanitation of area and utensils, Settle plate method, Media fill validation technique, Antimicrobial preservative effectiveness test, Safety test of different raw materials and formulated products, Microbial limit test, Microbiological monitoring of empty bottle, Microbiological monitoring of clean room including laminar air flow of microbiology lab, different methods of microbial monitoring systems for environment in pharmaceutical industry.	9 hrs	CLO3 CLO4
6.	Immunological products: Active antigenic products, attenuated, inactivated and extract, viral and bacterial. Passive products, gamma globulin.	3 hrs	CLO5
7.	Bacterial resistance: Definition, mechanisms, examples, prevention and drug development.	3 hrs	CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)					
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
	Class test/ Quiz/Viva/ Case study	10%							
	Assignment/ Presentation	5%							
	Midterm Exam	30%							
	Final Exam	50%							
	Total	100%							

Learning References:

1. Microbiology- Michael J. Pelczar, Noel R. Kreig and E.C.S Chan. 5th edition, Tata Mc Graw Hill Publishing Company Limited, New Delhi.
2. Microbiology: An Introduction- Tortora, Berdell R. Funkee & Case, 8th edition, Prentice-Hall.
3. Biology of Microorganisms- TD Brock, MT Madigan, JM Martinko, and J. Parker, 7th edition, Prentice-Hall, Englewood Cliffs, NJ.
4. Prescott and Dunn's Industrial Microbiology- Samuel Cate Prescott, Cecil Gordon Dunn and Gerald Reed, 4th edition, Chapman & Hall.
5. Pharmaceutical Microbiology- Harris.
6. Fundamental Principles of Bacteriology- A.J. Salle, 7th edition, Mc Graw Hill Book Company.
7. Cooper and Gunn's Dispensing for Pharmaceutical Students- S. J Carter, 12th edition, Pitman Medical.
8. Microbiology- Lachman and Whistriche.

Course Code	0916-317
Course Title	Medicinal Chemistry-II Lab
Year & Semester	3rd Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Medicinal Chemistry is aimed at students with a strong interest in the biological aspects of chemistry as well as traditional chemistry that covers biochemistry, medicines, drug discovery, and the major disease areas.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Synthesize medicinal compounds.
CLO2	Determine the amount of drug present in a sample.
CLO3	Estimate purity of drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓	✓	✓			
CLO2			✓	✓	✓	✓		
CLO3	✓	✓				✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Synthesis of organic compounds of medicinal importance (Paracetamol)	4 hrs	CLO1
2.	Synthesis of organic compounds of medicinal importance (Acetanilide)	4 hrs	CLO1
3.	Synthesis of organic compounds of medicinal importance (Ester)	4 hrs	CLO1
4.	Quantitative estimation of aspirin in tablets by UV-Visible spectrophotometer	4 hrs	CLO2
5.	Quantitative analysis of paracetamol by UV-Visible spectrophotometer	4 hrs	CLO2
6.	Molecular docking study of Single Ligand-Protein Interaction	4 hrs	CLO1,CLO2 CLO3
7.	Molecular docking study of multiple Ligand-Protein Interaction	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
	Attendance	5%			10-20%					
	Evaluation	15.5%			10-20%					
	Experiments	33%			20-30%					
	Experiment Result	15.5%			20-30%					
	Report/khata	15.5%			20-30%					
	Viva voce	15.5%			20-30%					
	Total	100%								
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles			Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create

Learning References:

1. Textbook of Organic Chemistry- Bahl and Bahl
2. Organic Chemistry- Morrison and Boyd
3. Organic Chemistry (Vol I and II)- Finar
4. Feisers' Reagents for Organic Synthesis- Fieser
5. A Textbook of Medicinal Chemistry- Wilson and Gisvold
6. Medicinal Chemistry- Burger

Course Code	0916-318
Course Title	Pharmacology-II Lab
Year & Semester	3rd Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmacology is the study of drugs. This course will provide the students with the basic information of the drugs working on the endothelium, endocrine system and the central nervous system, regarding their mechanism of action, biotransformation, side effects, contraindications and their clinical uses.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate routes of drug administration in animals.
CLO2	Identify suitable anesthetics for animal studies.
CLO3	Develop skills of common laboratory techniques and laboratory animal maintenance.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓					
CLO2	✓	✓	✓		✓			
CLO3			✓		✓	✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Estimation of salicylic acid in blood plasma after administration of aspirin by ferric chloride colorimetric method	4 hrs	CLO1 CLO3
2.	Estimation of paracetamol in blood plasma after administration (colorimetric method)	4 hrs	CLO1 CLO3

3.	Determination of concentration of local anesthetic (lidocaine/procaine) using uv-visible spectrophotometric	4 hrs	CLO1 CLO3
4.	Test for qualitative analysis of local anesthetics	4 hrs	CLO2,CLO3
5.	Estimation of antihistamines in blood after administration (colorimetric method)	4 hrs	CLO2 CLO3
6.	Determination of concentration of propranolol by uv-visible spectrophotometric method	4 hrs	CLO1 CLO3
7.	Estimation of furosemide by ferric chloride colorimetric method	4 hrs	CLO1

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Pharmacological Basis of Therapy- Goodman & Gillman
2. Medical Pharmacology- Meyer
3. Medical Pharmacology- Goth

Course Code	0916-319
Course Title	Pharmaceutical Technology-I Lab
Year & Semester	3 rd Year 1 st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmaceutical technology deals with the formulation of a pure drug substance into a dosage form. This course will introduce production methods and technology. It will focus on the rational use of different chemical compounds, solvents, polymers, and the manufacturing procedure for the formulation of dosage form of drugs.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe the use of pharmaceutical preparation source (pharmacopoeia, formulary, medical formulary (etc.) while preparing dosage form.
CLO2	Determine the most suitable method of preparation.
CLO3	Calculate the amount of material needed to prepare dosage form.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓		✓			✓
CLO2	✓	✓		✓	✓			✓
CLO3	✓	✓			✓			✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Formulation of oil-in-water emulsions	4 hrs	CLO1,CLO3
2.	Formulation of suspensions	4 hrs	CLO1,CLO2
3.	Formulation of syrups	4 hrs	CLO1,CLO3
4.	Formulation of non-medicated elixir	4 hrs	CLO1,CLO2
5.	Formulation of Cocoa Butter Suppositories	4 hrs	CLO1,CLO3
6.	Formulation of an using suitable ointment base	4 hrs	CLO1,CLO2
7.	Physical Evaluation of liquid formulation (Emulsions, syrup, suspension)	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy	Positive Reinforcement Tasks	Marks (Out of 100)						
				10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Comprehensive Pharmacy Review- Leon Shargel.
2. Pharmaceutical Technology –A practical manual: Sushama Talegaonkar
3. Laboratory Manual for Pharmaceutical Technology and Biopharmaceutics Experiments: Bijaya Ghosh, Rajeshri Dhurke.

Course Code	0916-321
Course Title	Organic Spectroscopy
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Organic Spectroscopy course involves the study of spectroscopic methods such as UV, IR, NMR, and mass spectroscopy with examples. It introduces the basic principles, instrumentation, and applications of UV, IR, NMR, and mass spectroscopy. Theory, instrumentation, and applications of radiochemical methods of analysis and use of radioisotope in pharmaceutical research are also discussed.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the principle of UV, IR, NMR, mass spectroscopy and radiochemical methods with examples.
CLO2	Describe various methods and graphical representation of compounds of spectral analysis.
CLO3	Develop and validate the analytical methods by using UV, IR, NMR, mass spectroscopy.

CLO4	Apply various spectroscopic techniques to identify organic, inorganic, and natural products.
CLO5	Explain the fundamentals of radioactivity, natural and radioactivity, radioactive decay, different types of radiation, radiation detection and their measurements.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓			✓	✓	
CLO2			✓		✓		✓	
CLO3		✓	✓			✓		
CLO4		✓	✓	✓			✓	✓
CLO5	✓		✓		✓		✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	a) Absorption spectroscopy: i) UV spectroscopy: Spectroscopy, radiation, electromagnetic spectrum, energy of molecule, electronic transition, Beer Lambert law, chromophore, auxochrome, absorption band, instrumentation. ii) IR spectroscopy: Principle, molecular vibration, classification of molecular vibration, degree of freedom, selection rule, factors, instrumentation, sampling techniques, finger print region, application.	20.5 hrs	CLO1 CLO2 CLO3 CLO4 CLO5
2.	Nuclear magnetic resonance spectroscopy: H-NMR spectroscopy: Introduction & theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling. ¹³ C - NMR spectroscopy, basic principle and application of 2DNMR spectroscopy.	10.5 hrs	CLO1 CLO2 CLO3 CLO4 CLO5
3.	Mass spectroscopy: Introduction, theory, the mass spectrum, determination of molecular formula, ionization technique, recognition of molecular ion, fragmentation process, applications.	11 hrs	CLO1 CLO2 CLO3 CLO4 CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Quantitative Pharmaceutical Analysis (Vol I & II)- Chatten
2. A Textbook of Pharmaceutical Analysis– K. A. Connors
3. Quantitative Inorganic Analysis (Vol I & II)- Vogel
4. Elementary Organic Spectroscopy – S. Chand and Y. R. Sharma
5. British Pharmacopoeia
6. United State Pharmacopoeia.

Course Code	0916-322
Course Title	Pharmacology-III
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmacology-III course helps to develop knowledge about different pharmacological actions of drugs such as antidiabetic, anticancer, antiviral, antitubercular, antidiarrheal and antifertility agents. The main objective of the subject is to make students familiar with the wider concepts of the pharmacological action of some specific drugs.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Explain the pharmacokinetics and mechanism of drug action at organ system/sub cellular/macromolecular level.
CLO2	Evaluate the drug mechanisms and their relevance in the treatment of diseases and poisoning.
CLO3	Classify drugs based on their therapeutic utility and explain the pharmacology of drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓	✓			✓	✓
CLO2	✓	✓			✓	✓	✓	✓
CLO3	✓	✓		✓				

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Hormones and hormone related antagonist: a) Anti-diabetic drugs: Introduction and classification of diabetes, anti-diabetic drug: classification, chemistry, mode of action, pharmacokinetics, indications, contra-indications, dose, adverse effects, and drug interaction of the following individual class of drugs: oral hypoglycemic agents: (i) sulfonylureas (ii) biguanides. Hormone preparation: insulin, management of diabetes mellitus. (iii) incretin-based drugs (sitagliptin). b) Thyroid and anti-thyroid drugs. c) Estrogens and progesterone.	7.5 hrs	CLO1 CLO2
2.	Enzymes in therapy: General properties of enzymes and their mode of actions, enzyme activators and inhibitors; enzymatic basis of drug action; pharmaceutical importance of enzymes.	3 hrs	CLO3
3.	Anticancer agents: a) Definition of cancer, types of cancer, genesis of cancer cell, pathogenesis, classification of an anticancer drug. b) Alkylating agents: Nitrogen mustard, alkyl sulphonates and nitrosoureas. c) Anti-metabolites: (i) Folic acid analog (ii) Pyrimidine analog (iii) Purine analog and related inhibitors. d) Natural products: (i) Vinca alkaloids (ii) Antibiotics (iii) Miscellaneous agents (metal complexes, radioisotopes, hormones, etc.)	10.5 hrs	CLO1 CLO2 CLO3

4.	Pharmacological studies of various groups of drugs: a) Drugs used in the treatment of tuberculosis: Antibiotics and Chemotherapeutics: Isoniazid, rifampicin, pyrazinamide, ethambutol, streptomycin, gentamicin, para-amino salicylic acid etc. b) Antidiarrheal agents: Introduction, general mechanism of diarrhea, classification of antidiarrheal drugs, ORS, tetracycline, streptomycin, sulfonamide, loperamide and anti-spasmodic drugs, etc. c) Anti-fertility drugs: Different methods of contraception, mechanism of oral contraceptives, mechanical barriers, implants, foams, etc. d) Drugs used in Acquired Immune Deficiency Syndrome (AIDS): Nucleoside Reverse Transcriptase Inhibitors (NRTIs) (lamivudine, tenofovir, zidovudine) e) Drug affecting uterine motility: Oxytocin, prostaglandin, ergot alkaloids.	21 hrs	CLO1 CLO2 CLO3
----	--	--------	----------------------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture		10-20%					
	Class test/ Quiz/Viva/ Case study	10%				10-20%				
	Assignment/ Presentation	5%					20-30%			
	Midterm Exam	30%					20-30%			
	Final Exam	50%					20-30%			
	Total	100%					20-30%			
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create

Learning References:

1. Pharmacological basis of therapeutics - Goodman & Gillman
2. Medical Pharmacology – Katzung
3. Medical Pharmacology- Meryer
4. Essential Pharmacology – K.D. Tripathy
5. Basic and Clinical Pharmacology – BG Katzung.

Course Code	0916-323
Course Title	Pharmaceutical Technology-II
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical technology deals with preparation, dosage and side effects of different medicines in details. The course provides the students basic knowledge on the manufacturing process and different machines used in the production of the tablets, capsule. It gifts a platform for knowing about the microencapsulation technology. This course will also provide the students with basic terminology and concepts in pharmaceutical technology as a support to the following study of the different pharmaceutical dosage forms as well as packaging systems for pharmaceuticals.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the elaborated knowledge on solid dosage forms such as powders, granules, tablets, coated tablets and capsules.
CLO2	Demonstrate the terminology and concepts used in Pharmaceutical Technology and the technical and scientific aspects inherent to drugs and packaging.
CLO3	Develop scientific knowledge for the identification, formulations, preparation, standardization, container and closure system for pharmaceutical products, quality control, and uses of drugs and medicines.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓						✓
CLO2	✓	✓						✓
CLO3	✓			✓				

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Powder dosage form: Introduction, classification of powders according to the manner of their dispensing, divided powders, simple and compound powders for internal use, powders for reconstitution, bulk powders for internal use: oral bulk powders for internal use, antacid oral bulk powders for reconstitution for internal use.	3 hrs	CLO1 CLO2 CLO3

2.	Formulation and Manufacturing of tablets: Manufacturing of tablets by wet granulation, dry granulation & direct compression. Granulation of powders for tableting, advantages and disadvantages of different processes, processes and machineries used in tablet manufacturing.	9 hrs	CLO1 CLO2
3.	Common tableting problems and Evaluation of tablets: Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, in-process quality control, study of common tableting problems.	3 hrs	CLO1 CLO2 CLO3
4.	Tablet coating: Definitions and classification of coating methods, advantages, and disadvantages of coated tablets. Different methods of coating: Sugar coating: different stages of sugar coating, problems of sugar coating. Film coating: Theory of film coating, film formers, plasticizer, solvents. Enteric coating: Enteric coating polymers, formulations of enteric coating. Dry coating (compression coating). Comparison between sugar coating and film coating. Aqueous film coating techniques. Modern film coating materials and coating formulations. Problems of organic and aqueous film coating. Coating machines: Conventional coating machines, perforated coating machines, fluidized coating machines.	12 hrs	CLO1 CLO2 CLO3
5.	Tablet coating: Definitions and classification of coating methods, advantages, and disadvantages of coated tablets. Different methods of coating: Sugar coating: different stages of sugar coating, problems of sugar coating. Film coating: Theory of film coating, film formers, plasticizer, solvents. Enteric coating: Enteric coating polymers, formulations of enteric coating. Dry coating (compression coating). Comparison between sugar coating and film coating. Aqueous film coating techniques. Modern film coating materials and coating formulations. Problems of organic and aqueous film coating. Coating machines: Conventional coating machines, perforated coating machines, fluidized coating machines.	7.5 hrs	CLO1 CLO2 CLO3
6.	Hard gelatin capsules: Definition and classification, advantages and limitations of capsule dosage form, gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories. Problems in capsule manufacturing, quality control methods of capsules, packaging of capsules.	3 hrs	CLO1 CLO2 CLO3

7.	Microencapsulation technology: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.	3 hrs	CLO1 CLO2 CLO3
8.	Containers and closures for pharmaceutical packaging and accessories: Blister packaging machine, strip packaging machine. cGMP & USP requirements on containers and closures, containers for bulk drug substances, AAO recommended color coding of caps and labels for topical ophthalmic medications, information that typically should be submitted for liquid-based oral and topical drug products,	1.5 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. The Theory and Practice of Industrial Pharmacy- Lachman
2. American Pharmacy- Sprowl
3. Pharmaceutics- Aulton
4. Remington's Pharmaceutical Sciences- AR Gennaro
5. Dispensing of Medication- Husa& martin
6. Pharmaceutical Practice- Aulton
7. An introduction of Pharmaceutical Formulations- Fishburn
8. An introduction to Pharmaceutical Productions- Polderman
9. The extra Pharmacopoeia- Martindale.

Course Code	0916-324
Course Title	Bio-pharmaceutics-I
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Bio-pharmaceutics comprises the complex processes of drug delivery, the subsequent response and reaction to the drugs and related research together. It includes the study of activities and related mechanisms of action in living organisms. It is the study of optimization of the pharmacological and therapeutic activities of drugs in living organisms and involves identification of the factors influencing their bioavailability. This course introduces students to the concepts of biopharmaceutics including the processes of absorption, distribution, metabolism, and excretion of drugs. The basic principles and concepts of biopharmaceutics that affect the absorption and distribution of drugs in the body will be discussed. This course will also cover the routes of administration and effect of the physicochemical properties of drugs and drug products on the bioavailability of these drugs. In addition, diffusion and drug release following drug administration will constitute a major part of the course. The physicochemical properties of the drug product and the relevant physiology leading to the optimization of drug delivery by any route of administration will be emphasized.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the basic concepts of biopharmaceutics as well as their role in pharmaceutical drug development.
CLO2	Identify the physiological, physicochemical and dosage form-related factors that affects drug absorption from different dosage forms and their distribution and elimination. Identify patient factors which require a modification of the regular posology and administration of prescribed drugs.
CLO3	Develop the knowledge about the proper way to administer oral drugs based on sound biopharmaceutical justification and to trouble shoot for issues that may arise during generic drug development at industrial level.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓				
CLO2				✓				
CLO3		✓	✓	✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction to Pharmaceutics and Biopharmaceutics: Definition, fate of drug in the body, plasma level time curve, measurement of drug concentration, significance of measuring drug concentration.	3 hrs	CLO1 CLO2 CLO3
2.	Gastrointestinal Absorption of Drugs: a) Biological consideration: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc. b) Physicochemical consideration: pka and gastrointestinal absorption, pH-partition theory and other physicochemical factors. c) Dosage form consideration: Role of different dosage form like solution, suspension tablet, capsule, emulsion etc. on gastrointestinal absorption. d) Disintegration and dissolution of drugs.	10.5 hrs	CLO2 CLO3
3.	Distribution of Drugs: a) Important pharmacokinetic parameters: Biological half-life, apparent volume of distribution, area under the curve, absorption, and elimination rate constant etc. b) Interpretation of drug-plasma level curve. c) Drug-protein interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of bindings sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination, and pharmacological effects of drugs.	10.5 hrs	CLO2 CLO3

4.	Drug Clearance: a) Theoretical aspects of drug elimination, excretion, and biotransformation. b) Renal elimination: Glomerular filtration, active tubular secretion, tubular reabsorption, determination of renal clearance. c) Biotransformation of drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michelis-Menten equation), hepatic elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance). d) Biliary excretion of drug.	10.5 hrs	CLO2 CLO3
5.	Bioavailability and bioequivalence: Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute to bioavailability, methods of assaying bioavailability, criteria for bio-equivalence studies. Drug product selection based on bio-availability testing.	7.5 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)					
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture						
	Class test/ Quiz/Viva/ Case study	10%							
	Assignment/ Presentation	5%							
	Midterm Exam	30%							
	Final Exam	50%							
	Total	100%							

Learning References:

1. Biopharmaceutics & Clinical Pharmacokinetics- M. Gibaldi
2. Biopharmaceutics & Clinical Pharmacokinetics- Notari
3. Biopharmaceutics & Relevant Pharmacokinetics- T.G. Wagner
4. Biopharmaceutics & Drug Interactions- Cadwallader
5. Applied Biopharmaceutics and Pharmacokinetics – Leon Shargel

Course Code	0916-325
Course Title	Pharmaceutical Quality Assurance & Validation
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course focuses on the concept of preventing mistakes and defects in manufactured products and avoiding problems when delivering products or services to customers. It includes importance of pharmaceutical analysis in the quality control of drugs, sources of quality variation, control of quality variation, sampling techniques, analytical, biological and clinical testing, quality control and evaluation of package performance. Statistical methods for assessment of reliability and reproducibility of results, in-process quality control for manufacturing reliability and Good Manufacturing Practices (GMP) are also described. Pharmaceutical validation concept is also illustrated in this course.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the basic knowledge of pharmaceutical assurance and validation including BSTI (DA) policies for quality in pharmaceutical industries.
CLO2	Develop collaborative and collegial practices and improve morale
CLO3	Develop validation master plan
CLO4	Explain importance of quality control in pharmaceutical industry
CLO5	Justify where to intervene to make effective and sustainable, continuous improvements in a pharmaceutical.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2	✓				✓			
CLO3	✓		✓					
CLO4	✓							✓
CLO5			✓	✓			✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Importance of pharmaceutical analysis in the quality control of drugs, sources of quality variation, control of quality variation. Set up of a quality control oratory for pharmaceutical analysis, personnel, equipment, environments, etc. Types of specifications, testing program and methods. BSTI (DA) policies for quality in pharmaceutical industries. Theory and basic concept of current good manufacturing practice (cGMP), ISO-9000, ISO-9001 and ICH.	9 hrs	CLO1 CLO2 CLO4 CLO5
2.	Quality control of pharmaceutical dosage form: Concept of quality control and in process control, selection and testing of major raw materials input, causes of poor quality. Methods of drug sampling, quality control of raw materials, packaging materials, bulk product, finish product. a) Pharmacopeial test and specifications, standardization of pharmaceutical products. b) In process quality control of pharmaceutical dosage form. c) Quality control of packaging materials.	12 hrs	CLO1 CLO2 CLO4 CLO5
3.	Total quality management (TQM): Quality management consideration, quality motivation, total quality management.	3 hrs	CLO1 CLO2
4.	Pharmaceutical validation concept: a) Pharmaceutical room and equipment validation: Importance and process of room and equipment validation. b) Pharmaceutical process validation: Importance, type of process validation, validation of dissolution process, mixing process, granulation process, tablet compression process, tablet coating process, capsule filling process, injection vial filling process. c) Pharmaceutical analytical method validation: Importance, linearity, accuracy, precision, limit of detection, limit of quantification, heat sensitivity and system suitability. d) Post marketing validation.	12 hrs	CLO1 CLO2 CLO3 CLO4 CLO5

5.	Concept of statistical quality control: Normal frequency distribution, Q.C. charts, sampling and sampling plan, binomial distribution, tests of significance, consumer acceptance testing, analysis of variance (ANOVA) and experimental design, bioavailability and crossover design, regression correlation.	6 hrs	CLO1 CLO2 CLO4 CLO5
----	---	-------	------------------------------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Assurance of Quality Pharmaceuticals- Dr. M. Shah Nawaz Khan
2. Pharmaceutical Regulatory Affairs and Standards- Professor Dr. Md. Shah Amran
3. British Pharmacopoeia
4. United State Pharmacopoeia
5. European Pharmacopoeia
6. Introductory Statistics- A.H.M Rahmatullah Imon

Course Code	0542-326
Course Title	Research Methodology
Year & Semester	3rd Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Biostatistics is an important tool in pharmacological and pharmaceutical research that is used to summarize (descriptive statistics) experimental data and analyze correlated data produced by longitudinal measurements taken over time. Topics include study design, exploratory data analysis techniques and linear mixed effects regression models. The objective of the course is to educate students with basic statistical knowledge. It is essential to improve health, patient care and medication-related outcomes through education and research.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe the statistical approach in medical and pharmaceutical science
CLO2	Apply appropriate statistical methods for analyzing one or two variables
CLO3	Develop idea about correlation of measurement and regression analysis

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓					✓	
CLO2		✓	✓			✓		
CLO3	✓	✓			✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Application in pharmacy, sample and population, simple and random sampling, sampling distribution and standard error, graphical and diagrammatic representation	10 hrs	CLO1 CLO2
2.	Regression analysis: Basic idea of regression, calculation of regression coefficient, standard error and significance test. Partial correlation and multiple regressions with two and more than two independent variables.	10 hrs	CLO2 CLO3
3.	Bio-statistics and Pharmaceutical calculation: Dosage calculation, statistical methods utilized in pharmaceuticals, one-way and two-way analysis of variance, design of experiment.	9 hrs	CLO1 CLO2 CLO3
4.	Basic idea of significance test: Simple significance tests based on the normal distribution, comparison with a known standard, comparison of means of two large samples, t- test.	9 hrs	CLO1 CLO2 CLO3

5.	Study design: Experimental and non-experimental design, cross sectional study, cohort study, case-control study.	4 hrs	CLO1 CLO2 CLO3
----	---	-------	----------------------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. An Introduction to the Theory of Statistics—R. N. Shil
2. Medical & Pharmaceutical Statistics- JMA Hannan, PhD

Course Code	0916-327
Course Title	Pharmacology-III Lab
Year & Semester	3rd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmacology-III lab deals with the study of how a medication affects the biological system and how the body reacts to it. This lab course focuses on pharmacological action of different medicines on toad such as furosemide, mannitol, CNS stimulant, CNS depressants etc. The field of study includes drug sources, chemical characteristics, biological effects, and therapeutic applications. Depending on a variety of physiological factors, these effects might be helpful or harmful.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Achieve expanded practical knowledge on mode of action of different medicines.
CLO2	Observe practically the effect of chemotherapeutic agents on diseased rats.
CLO3	Analyze the variations of effect of medicines.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓				✓
CLO2		✓			✓			
CLO3		✓			✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Effect of CNS stimulant, CNS depressants on mice	4 hrs	CLO1 CLO2
2.	Effect of diuretics (furosemide) on mice	4 hrs	CLO1 CLO3
3.	Effect of diuretics (mannitol) on mice	4 hrs	CLO1 CLO2
4.	Effect of local anesthetic on rat tails	4 hrs	CLO1 CLO3
5.	Study of mydriatic and myotic effects on rabbit's eye (e.g; atropine, physostigmine etc.)	4 hrs	CLO1 CLO2
6.	Effect of pilocarpine on saliva secretion of rat	4 hrs	CLO1 CLO3
7.	Estimation of blood uric acid by enzymatic method	4 hrs	CLO1 CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Pharmacological Basis of Therapy- Goodman & Gillman
2. Medical Pharmacology- Goth
3. Lippincott's Illustrated Reviews on Pharmacology- Richard A. Harvey, Pamela C. Champe.

Course Code	0916-328
Course Title	Pharmaceutical Technology-II Lab
Year & Semester	3rd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course consists of fundamental laboratory techniques in field of pharmaceutical manufacturing. In this course students will gain practical experiences on preparations, problems encountered during preparation as well as on the physical evaluation of tablets and capsule. Moreover, students will also get basic idea how to identify defects that forms at the time of production.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Operate one punch tablet compression machine and capsule filling machine.
CLO2	Demonstrate the application of tablet compression, capsule filling procedure and granulation.
CLO3	Handle laboratory apparatus with ensuring general precautions, safety measures and maintenance.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓					
CLO2	✓	✓	✓					✓
CLO3	✓	✓	✓		✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Preparation and Compounding of Tablets	4 hrs	CLO1,CLO2 CLO3
2.	Preparation and Compounding of Capsules	4 hrs	CLO1,CLO2 CLO3
3.	Preparation and Compounding of Suppositories	4 hrs	CLO1,CLO2 CLO3
4.	Physical evaluation of Capsule: Appearance and weight variation Test	4 hrs	CLO1,CLO2 CLO3
5.	Physical evaluation of Tablets and: Appearance and weight variation Test	4 hrs	CLO1,CLO2 CLO3
6.	Study of different percentage of lubricant in tablet formulation	4 hrs	CLO1,CLO2 CLO3
7.	Formulation and manufacturing of dispersible aspirin tablet	4 hrs	CLO1,CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture		10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Evaluation	15.5%		Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. The Theory and Practice of Industrial Pharmacy- Lachman
2. American Pharmacy- Sprowl
3. Pharmaceutics- Aulton
4. Remington's Pharmaceutical Sciences
5. Dispensing of Medication- Husa& martin
6. Pharmaceutical Practice- Aulton
7. An introduction of Pharmaceutical Formulations- Fishburn
8. An introduction to Pharmaceutical Productions- Polderman
9. The extra Pharmacopoeia- Martindale.

Course Code	0916-329
Course Title	Pharmaceutical Quality Assurance & Validation Lab
Year & Semester	3rd Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

The course covers the basics of quality assurance processes and methods. It deals with the various aspects of quality control and quality assurance of pharmaceutical industries. By this course, the students will gain practical experiences on the important aspects like good laboratory practice, cGMP, QC tests, documentation, quality certifications and will efficiently apply the experiences in their professional tenure.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the cGMP aspects and the documentation and their importance in a pharmaceutical industry.
CLO2	Analyze the samples by the QC test and prepare the well documents for quality certification applicable to pharmaceutical industries.
CLO3	Develop the skills of QC and QA departments and their responsibilities in pharmaceutical industries.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓				✓			
CLO2		✓	✓		✓			✓
CLO3	✓	✓	✓	✓	✓	✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Document preparation and maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality Audit	2 hrs	CLO2
2.	Calibration of laboratory instruments (pH meter, analytical balance etc.)	2 hrs	CLO2 CLO3
3.	Validation of laboratory instruments (pH meter, analytical balance etc.)	2 hrs	CLO2 CLO3
4.	Quality control of: a) Raw materials and finished products b) Packaging materials used in different dosage forms	8 hrs	CLO2 CLO3
5.	Maintenance of stores of raw materials, chemicals, equipments and finished products	4 hrs	CLO2 CLO3
6.	Analysis the supplied sample with justification	8 hrs	CLO2, CLO3
7.	Documentation and Audit Trail: Deviation, CAPA, Change control preparation	2 hrs	CLO1

Teaching-Learning Approach	Assessment Strategy	Positive Reinforcement Tasks	Marks (Out of 100)						
			10-20%						
			10-20%						
			20-30%						
			20-30%						
			20-30%						
			20-30%						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance 5% Evaluation 15.5% Experiments 33% Experiment Result 15.5% Report/khata 15.5% Viva voce 15.5% Total 100%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create

Learning References:

1. Applied Biopharmaceutics and Pharmacokinetics – Leon Shargel
2. The Theory and Practice of Industrial Pharmacy- Lachman

Course Code	0916-330
Course Title	Oral Assessment-III
Year & Semester	3rd Year 2nd Semester1
Course Credit	15
Credit Hours	100
Total Marks	

Course Description:

Oral Assessment is a Latin expression that was used in Catholic seminary education to refer to oral exams (it literally means, “living voice”). Oral exams are used not as a substitute, but as a complement to written exams. They are a way to ask what is not feasible through the written format. Ostensibly, the rationale is that teachers can use the oral format to probe, challenge and critically assess what a student really knew about a particular topic.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate verbally the depth of understanding, thinking and problem-solving ability.
CLO2	Interact with courage and spontaneity beyond nervousness in face-to-face interview.
CLO3	Present their concepts systematically in oral form and exhibit preparedness for future job interview.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓			✓		
CLO2				✓	✓		✓	✓
CLO3		✓				✓	✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	All courses of 6 th semester	15 hrs	CLO1 CLO2 CLO3

Teaching- Learning Approach	Assessment Strategy		Positive Reinforcement Tasks
Discussion of lecture Overview of courses Question-Answer session Text books PowerPoint lecture notes Websites Videos/Documentaries Scientific articles	Attendance	10 %	Feedback/Response Individual discussion Group discussion Misconception check Summarization of lecture
	Viva (Attire, Attitude, Speaking, Knowledge)	90 %	
	Total	100%	

Learning References:

1. All textbooks of this semester

Course Code	0916-411
Course Title	Medicinal Chemistry-III
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Advanced Medicinal Chemistry is a course that will provide in-depth knowledge of the design, synthesis, and biological evaluation of small organic substances as potential lead compounds. It is also part of medicinal chemistry that evaluates the properties of existing drugs. The use of plants, minerals, and animal parts as medicines has been recorded since the most ancient civilizations. It enables the students to understand the concepts of how the chemical natures of small molecules influence or exhibit biological activities and how the structural modification influences potential activity.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the basic concept of drug design and development, modern techniques of drug design, chemistry, uses, SAR of different drug and biosynthetic pathway of natural products.
CLO2	Analyze molecular properties related to the chemical structure of the drug.
CLO3	Describe drug-target interactions and scopes of modification for different drugs.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2	✓			✓				✓
CLO3	✓			✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Drug design and Discovery: a) Sources of drugs, cost and place of development of drugs, search for new drugs, genesis of drugs. b) Antihypertensive drugs, β -blocker, H ₂ -blockers, semi-synthetic penicillin's, quinolone derivatives and anti-diabetic drugs. c) Role of biological half-life ($t_{1/2}$), metabolism of drug, as drug design.	7.5 hrs	CLO1 CLO2 CLO3

2.	Chemistry, uses and SAR of the following drugs: a) Psychotropic drugs: Sedatives, hypnotics, classification, barbiturates, non-barbiturates, SAR and synthesis. b) Antidepressant drugs: Classification, SAR and synthesis of phenothiazine, TCA and MAOI. c) Anti-neoplastic drugs: Cancer, cause, classification of anticancer drug.SAR and synthesis of alkylating agent and anti-metabolites. d) Membrane acting drugs: i) Acetylcholine: Occurrence, SAR and synthesis of acetylcholine. ii) Catecholamine: Occurrence, SAR, synthesis, inactivation.iii) Serotonin: Occurrence, SAR, synthesis, inactivation. e) Anti-malarial drugs: History, classification, drug development strategy, synthesis and SAR.	24 hrs	CLO1 CLO2 CLO3
3.	Biosynthetic pathway of the following natural products: a) Alkaloids: Definition, classification, properties, stability, separation, SAR, synthesis. b) Terpenoids: Terpene, terpenoids, essential oils, isolation, classification, synthesis, isoprene rule. c) Flavonoids: Source, structure, classification, synthesis, biotransformation and use. d) Vitamins: Vitamin, pro-vitamin, anti-vitamin, discovery, properties, classification, absorption, storage, deficiency, toxicity, medicinal and metabolic role, destruction, synthesis of vitamin A,B, C, D and E.	10.5 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%					
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Organic chemistry, Natural products: (vol I and II) – O.P. Agarwal
2. Organic chemistry: The Fundamental principles (vol I and II) – Finar
3. Fundamentals of medicinal chemistry – G. Thomas
4. Wilson and Gisvold's organic medicinal and pharmaceutical chemistry- J. Block, J. Beale.
5. Burger's medicinal chemistry and drug discovery (vol I – VI) – D.J. Abraham.

Course Code	0916-412
Course Title	Bio-pharmaceutics-II
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course is devoted to the exploration and examination of the physical and physicochemical behavior of drugs, dosage forms, and drug delivery systems in physiological milieu and their implications for pharmaceutical care. Drug absorption processes, bioavailability, and bioequivalence will be highlighted. Pharmacokinetic and pharmacodynamic concepts, including absorption kinetics, volume of distribution, and compartmental models, will be introduced to the student.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the different kinds of compartment model, determination of plasma concentration and calculation of volume distribution in one compartment open model, two compartment model and three compartment model.
CLO2	Analyze about zero order and first order absorption model, determination oral absorption rate through Wagner Nelson method and Loo Riegelman method.
CLO3	Evaluate the scientifically use equations which will help them understand the processes that the drug undergoes inside the system and also the fate of this drug.
CLO4	Develop knowledge about multiple dosage regimens, drug accumulation, repetitive intravenous injection, multiple oral dosage regimen, loading dose, intravenous infusion etc.
CLO5	Create the knowledge about dosage adjustment in renal disease such as drug adjustment based on drug clearance, measurement of GER, calculation of creatinine clearance, dialysis and relationship between pharmacokinetic and therapeutic responses of a drug.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓		✓	✓	✓
CLO2	✓	✓				✓	✓	✓
CLO3	✓	✓				✓	✓	✓
CLO4	✓			✓		✓	✓	✓
CLO5	✓			✓		✓	✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Compartmental Analysis: Introduction: a) One compartment open model: determination of plasma concentration from one compartment open model, calculation of apparent volume of distribution, calculation of K from urinary excretion data. b) Multiple-Compartment models: i) Two compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant ii) Three compartment open model: method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.	9 hrs	CLO1 CLO3 CLO5
2.	Pharmacokinetics of drug absorption: Zero order absorption model, first order absorption model determination of absorption rate constants from oral absorption data: method of residuals Wagner Nelson method, determination of k_a from two compartment oral absorption data, Loo Riegelman method.	7.5 hrs	CLO2 CLO3 CLO5
3.	Multiple dosage regimens (MDR): Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bio-equivalency from MDR.	7.5 hrs	CLO2 CLO3
4.	Intravenous infusion: One compartment model drugs, two compartment model drugs, infusion plus loading dose.	6 hrs	CLO3 CLO4
5.	Dosage adjustment in renal disease: Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance, method based on changes in the elimination rate constant, measurement of glomerular filtration rate (GER), calculation of creatinine clearance from serum creatinine concentration. Dose adjustment based on monogram. Giusti Hayton method, Wagner method. Extracorporeal removal of drugs, dialysis.	6 hrs	CLO3 CLO4

6.	Non-compartmental analysis, physiologic-pharmacokinetic model, statistical moment, mean residence time etc.	3 hrs	CLO3
7.	Relationship between pharmacokinetic and therapeutic responses.	3 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Biopharmaceutics & Clinical Pharmacokinetics- M. Gibaldi
2. Biopharmaceutics & Clinical Pharmacokinetics- Notari
3. Biopharmaceutics & Relevant Pharmacokinetics- T.G. Wagner
4. Biopharmaceutics & Drug Interactions- Cadwallader
5. Pharmacokinetics- M. Gibaldi & D. Perriore.
6. Applied Biopharmaceutics and Pharmacokinetics – Leon Shargel.

Course Code	0916-413
Course Title	Pharmaceutical Regulatory Affairs
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical Regulatory Affairs is a unique combination of science and management to achieve a commercially important goal within a drug-development organization. Pharmaceutical Regulatory Affairs is a profession developed from the intention of governments to protect public health by controlling the safety and efficacy of products including pharmaceuticals, veterinary medicines, medical devices, cosmetics so that those supplied products make a worthwhile contribution to public health and welfare.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Explain basic requirements for drug registration and illustrate different stage and critical parameters of registration.
CLO2	Describe the ever-changing legislation in all the regions in which a company wishes to distribute its products.
CLO3	Develop the skills on legal and scientific restraints and requirements.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓				✓			✓
CLO2				✓	✓			✓
CLO3				✓	✓	✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Definition of law, act, regulation, scope & goals for Regulatory Affairs, contribution of Regulatory Affairs Department in a pharmaceutical company, function of regulatory professionals, role of pharmacy community in Bangladesh, the role of pharmacists in operating and maintaining model pharmacy and model medicines shops.	4 hrs	CLO3

2.	Regulations and laws governing the practices of pharmacy in Bangladesh: Control of drug advertisements and prices of patented and trademarked medicine, proprietary medicine, regulation of cosmetics and poison control, approval process, format and registration process of pharmaceuticals in Bangladesh, rules and regulations for controlling poisons and narcotic materials in Bangladesh.	4 hrs	CLO1 CLO2 CLO3
3.	An introductory study on the policies, sales, regulation, and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons in Bangladesh (With latest amendments): The Drug Act 1940 (XXIII of 1940) The Drug Ordinance 1982 The Drug Control Ordinance 1982 (Ordinance No. VIII of 1982), its amendments Drug Control Guideline 2006 The National Drug Policy 1982 The National Drug Policy 2005 and 2016 for regulation of process of registration, manufacture, distribution, sale, import and export of drug in Bangladesh The narcotics (Control) act 1990 The Poisons Act 1919, and related amendments. The Pharmacy Ordinance 1976 The National Health Policy 2011 The Quality Policy 2017 and related amendments.	6 hrs	CLO1 CLO2 CLO3
4.	Pharmacists Code of Ethics: Values, behavior and ethical norms in pharmaceuticals, relationship of trust, ethical considerations during pharmacy practice, self-regulation.	4 hrs	CLO2 CLO3
5.	cGMP of pharmaceutical manufacturing, Evolution and Principles of cGMP, Schedule-M, WHO-GMP requirements, European Union (EU), United States Food and Drug Administration (USFDA), guidelines on pharmaceutical manufacturing.	4 hrs	CLO1 CLO2 CLO3
6.	Regulatory requirements for new product approval: NDA, ANDA, regulatory inspection system, approval process, format and registration of API, biologics, novel therapies, special categories in Bangladesh, stability study, BE study, validation, and qualification.	4 hrs	CLO1 CLO2 CLO3

7.	Pharmaceutical Regulatory Organizations (Bangladesh): Scope and functions of Pharmacy Council of Bangladesh (PCB) and functions and activities of Directorate General of Drug Administration (DGDA).	4 hrs	CLO2 CLO3
8.	Pharmaceutical Regulatory Organizations (Foreign): Introduction to international drug regulatory agencies, ICH and cGMP guidelines, Regulatory guideline of USFDA (USA), MHRA (UK), TGA (Australia), CDSCO (India), HEALTH CANADA (Canada), MCC (South Africa), ANVISA (Brazil), EMEA (European Union), SFDA (China), NAFDAC (Nigeria), MEDSAFE (New Zealand), MHLW (Japan), MCAZ (Zimbabwe), SWISSMEDIC (Switzerland), KFDA (Korea), MoH (Sri Lanka).	4 hrs	CLO1 CLO2 CLO3
9.	Harmonization of regulatory requirements: The international Conference on Harmonization (ICH) process, guideline to establish quality, safety and efficacy of drug substance and products, study of ICH, Common Technical Documents (CTD), harmonization of pharmacopeial standards, The International Organization for Standardization (ISO) 9000 series of quality system standards, ISO 14000, licensing of premises.	4 hrs	CLO1 CLO2 CLO3
10.	Global Agreements and Documentations: GATT, TRIPS, GAVI, Drug Master File, Dossier. Globalization of drug industries, Export import policy of drugs, WHO certification, trademarks, copyrights and patents, vendor qualification, post marketing surveillance.	4 hrs	CLO1 CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. The Pharmacy Ordinance, 1976. Ministry of Law and Parliamentary Affairs, Government of Bangladesh, Dhaka
2. The Drugs (Control) Ordinance, 1982, Ministry of Law and Land Reforms Government of Bangladesh, Dhaka
3. Drug Policy of Bangladesh, Ministry of Health and Population Control, Health Division, Dhaka
4. A Textbook of Forensic Pharmacy - B M Mithal. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh
5. Remington's Pharmaceutical Science

Course Code	0916-414
Course Title	Biochemistry and Molecular Biology
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Biochemistry and Molecular biology focus on DNA, RNA and protein synthesis in cells and is closely related to the fields of cell biology, genetics, genomics, and biochemistry. The field of molecular biology is focused especially on nucleic acids (e.g., DNA and RNA) and proteins macromolecules that are essential to life processes and how these molecules interact and behave within cells.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Achieve a wide range of theoretical knowledge on historical background of molecular biology as well as DNA, RNA and protein synthesis.
CLO2	Describe the molecular events that govern cell function while exploring the relevant aspects of biochemistry, genetics and cell biology and implement the knowledge in areas of medicine, agriculture, and biotechnology.
CLO3	Demonstrate the molecular basis of illnesses, mutation and apply different techniques in the field of research such as the gel electrophoresis and polymerase chain reaction etc.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							
CLO2	✓							✓
CLO3	✓	✓	✓	✓	✓			✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	General introduction and historical background of biochemistry and molecular biology: The Mendelian view of the world, Mendelian law, chromosomal theory of heredity, chromosomal determination of sex, chromosomal mapping of Annostment (Mendelian second law), and preliminary attempts to find a gene protein relationship.	3 hrs	CLO1 CLO2 CLO3
2.	Nucleic acid: Structure, isolation, purification and molecular weight determination, chemical and enzymatic hydrolysis and hybridization.	10.5 hrs	CLO1 CLO2 CLO3
3.	Central dogma of molecular biology: a) Replication: DNA replication, DNA types of DNA replication, and inhibitors of replication. b) Transcription: RNA synthesis and mRNA processing (post-transnational modification of mRNA, promoters, enhancers and transcriptional factor) in bacteria and yeast, inhibitors of transcription. c) Genetic code: Characteristic feature of genetic code, Wooble hypothesis with experimental codon. d) Translation: Structure of Ribosome, mechanism of translation, (protein synthesis), post-transnational modification, inhibitors of translation evidence, initiation and termination	18 hrs	CLO1 CLO2 CLO3
4.	Techniques in molecular biology: Polymerase chain reaction (PCR), DNA sequencing techniques, Southern, Northern and Western blotting. agarose gel electrophoresis, sds- PAGE TR-PCR, Invitro kinase assay Real time PCR, Reverse Transcriptase.	7.5 hrs	CLO1 CLO2 CLO3
5.	Mutation: Types of mutation, molecular mechanism of mutation, site specific mutagenesis, mutation hot spot,DNA repair mechanism, inheritant mutational diseases	3 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Lehninger Principles of Biochemistry by David Nelson, Nelson Michael Cox
2. Harper's Illustrated Biochemistry- Robert, Granner, Mayes
3. Text book of Biochemistry - west and Todd
4. Fundamentals of biochemistry -A.C. Deb.
5. Genes VI and VII - Benjamin and Lewin
6. Molecular Biology of THE CELL- Julian Hart Lewis

Course Code	0916-415
Course Title	Pharmaceutical Marketing
Year & Semester	4th Year 1st Semester
Course Credit	2
Credit Hours	28
Total Marks	80

Course Description:

Pharmaceutical Marketing course aims to provide comprehensive marketing overview in terms of concepts and techniques to students who are entering employment in any capacity within the field of pharmacy. This involves fostering the acquisition of knowledge and skills required to excel in the areas of value-added services, pharmaceutical marketing including distribution, promotion, pricing, and products. This course will examine the current pharmaceutical marketing environment from both an academic and practical perspective.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe all major marketing concepts and how to apply the marketing concepts over the pharmaceutical market.
CLO2	Demonstrate how the 4 P's are being composed with its importance for setting piece and developing quality for products.
CLO3	Apply marketing SWOT concepts, communication, public relations, pricing, and promotion techniques over any proposed product.
CLO4	Explain the different pharmaceutical marketing channels and utilize the responsibility of sales professional.
CLO5	Appraise their own interest in pursuing a career in the pharmaceutical or a related health care entity.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓	✓		✓	✓		✓
CLO2	✓	✓		✓	✓		✓	
CLO3	✓		✓	✓		✓		✓
CLO4		✓	✓				✓	✓
CLO5	✓	✓		✓		✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Definition, marketing concept, company orientation toward the market, changing environment and marketing responses, marketing and society, building customer satisfaction, value and retention- ethics in marketing.	4 hrs	CLO1 CLO2
2.	Analyzing marketing opportunities: Scanning the marketing environment for pharmaceutical industry, analyzing the pharmaceutical industry, analyzing competitors, marketing information system- measuring demand and forecasting sales, segmenting, targeting and positioning.	3 hrs	CLO3 CLO5
3.	Product management: Nature and types of products, product mix and line decisions, product innovation, diffusion of innovation, managing product life cycle, branding, marketing plan.	3 hrs	CLO1 CLO2
4.	Managing price: Setting the price, adapting the price, initiating and responding to price changes, prescription pricing and professional fees for pharmaceutical items.	3 hrs	CLO1 CLO2
5.	Marketing channels: Channel design decisions, management decisions- channel dynamics.	3 hrs	CLO4
6.	Marketing communication: Designing, budgeting, managing and coordinating integrated marketing communications, relationship in marketing of pharmaceutical products.	3 hrs	CLO1 CLO2
7.	Sales promotion: Purposes, major decisions on sales promotion- effective sales promotion techniques for pharmaceutical items.	3 hrs	CLO3 CLO4
8.	Public relations: Functions, definition, major decisions, objectives, public relations writing, public relationship in crisis management.	3 hrs	CLO1 CLO3

9.	Organizing, implementing and controlling of marketing programs: Marketing organization, marketing control, and marketing audit.	3 hrs	CLO5
----	--	-------	------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
	Class test/ Quiz/Viva/ Case study	10%			Remember	Understand	Apply	Analyze	Evaluate	Create
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Philip Kotler: Marketing Management
2. Cravens D W Hills Gerald F and Woodruff R B: Marketing Management
3. R Canfield: Salesmanship
4. Fraser P Seitel: Public Relations.

Course Code	0916-416
Course Title	Pharmaceutical Biotechnology
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical Biotechnology provides fundamental insights to the exploitation of biological processes for industrial and other purposes. The course introduces animal cell culture, fermentation, immobilization of enzymes approached by various methods with different operation modes. The strategies are to design efficient fermenters and develop methods for obtaining higher yields of commercial products at low cost with minimum energy consumption. Students will be able to learn the bioprocessing of industrial products e.g. wine, cheese, antibiotics, hormones, vaccines etc. The contents of immunology have been designed to take students step by step through fundamental components of immune system, activation and effector functions of the immune components, development of vaccines, immunopathogenesis and immunological techniques used for laboratory research and clinical diagnosis. Students will gain some fundamental knowledge about the vaccines and monoclonal antibody production. Furthermore, students should be aware that the science of immunology has already been successfully translated into clinical medicine.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes
	Upon completion of this course, the students will be able to:
CLO1	Describe the basic concept of biotechnology and its application on industrial basis as well as the significance of immunology, innate and adaptive immune defense, antigen processing and developments of vaccine in pharmaceutical sciences.
CLO2	Analyze and evaluate the process of industrialization of living organisms, the concept and application of monoclonal antibody technology, vaccine as well as use of microbes and mammalian cells for the production of pharmaceutical products depending on different pharmaceutical parameters
CLO3	Develop skills and approaches that are necessary to perform novel works in the field of biotechnology, immunology and immune intervention of diseases.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓		✓		✓
CLO2	✓	✓		✓	✓			✓
CLO3	✓		✓	✓			✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
	Pharmaceutical Biotechnology		
1.	General introduction: Definition and historical perspective, scope, potential and achievements, pharmacist and biotechnology, biotechnology and industry.	3 hrs	CLO1
2.	Fermentation technology: Fermentor/bioreactor types, configuration, mixing, aeration, fermentation modeling, product formation. Fermented pharmaceutical products: Antibiotics and Vitamins.	3 hrs	CLO1 CLO2 CLO3
3.	Enzyme biotechnology: Immobilization methods and application, enzyme kinetics, study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptozocin, amylases and proteases, immobilization of bacteria and plant cells, biosensors.	3 hrs	CLO1 CLO2 CLO3
4.	Animal biotechnology: Animal cell culture, culture media, maintenance of cell culture, primary and established cell culture and application of animal cell culture.	3 hrs	CLO1 CLO2 CLO3
5.	Recombinant DNA technology: Genes and vectors, isolation and purification. Restriction modification system, Restriction enzymes, Palindromic sequences of DNA. Enzyme required for cloning. Cloning of a gene into suitable vector, C-DNA library Cloning of insulin, interferon gene, Drug designing using biotechnological method. Use of reverse genetics in drug design.	6 hrs	CLO1 CLO2 CLO3
6.	Gene therapy: Gene therapy and molecular mechanism, mechanism of gene transfer, prerequisite of human gene therapy strategies, vehicles for gene transfer, gene therapy for HIV. Hereditary diseases, cancer and Antisense therapy: examples and its mechanism and use in different diseases.	6 hrs	CLO1 CLO2 CLO3

	Immuno-biotechnology:		
1.	a) Immune system: Principal components of the innate and adaptive immunity. b) Immune response: Types of adaptive immune response, active and passive immunity, cardinal feature of adaptive immune response, T and B cell activation, proliferation, and differentiation. c) The Major Histocompatibility Complex: Structure of MHC molecules (class-I and class-II), binding of peptides to MHC molecules. d) Antigen processing and presentation of T lymphocytes: Properties of antigen recognized by T lymphocytes, processing and presentation of antigen to CD4+ helper T lymphocytes and CD8+ cytolytic T lymphocytes.	12 hrs	CLO1 CLO2 CLO3
2.	a) Vaccines: Definition, objectives, types, manufacturing and quality control of medically important vaccines (Diphtheria, tetanus, BCG, Cholera, DTP, Polio, rabies, small and SARS-CoV-2) b) Hybridoma technology: Introduction, techniques of production and application of monoclonal antibodies. c Immunoblotting techniques: ELISA, immunofluorescence	6 hrs	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Pharmaceutical biotechnology- S.P. Vyas & V.K. Dixit.
2. Biotechnology and its applications in pharmacy- Giriraj Kulkarni T.
3. A text book of Immunology- A K Akram
4. Microbiology- Pelczar, Kreig and Chan
5. Pharmaceutical Microbiology- Harris
6. Review of Medical Microbiology and Immunology- Warren Levinson
7. Principles of Enzyme Technology- MY Khan, Farha khan, 2015
8. A textbook of biotechnology- R.C. Dubey.

Course Code	0916-417
Course Title	Project Work and Presentation
Year & Semester	4th Year 1st Semester
Course Credit	3
Credit Hours	6 Months
Total Marks	100

Course Description:

A project work will be given to the students by the teachers of the department and a dissertation should be submitted to the respective examiner and give a talk/presentation after completing the project. The report will be evaluated by the examiners of related field.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Develop and implement knowledge in pharmaceutical research.
CLO2	Calculate and interpret statistical data using various data analyzing tool.
CLO3	Document the research impact that a given intervention or exposure has relation on the health of a given population.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓				
CLO2		✓	✓		✓			
CLO3				✓	✓	✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Formulating a foundational concept for project work, doing a literature review, brainstorming and identifying potential research themes	1 month	CLO1
2.	Develop a study plan of proposed project work with an appropriate project title.	15 days	CLO1
3.	Preparation, purchase, collection of materials and instruments for project work	15 days	CLO1
4.	Searching and selection of project location, experimental design and laboratory set up to carry out project work	15 days	CLO1
5.	Carry out experiment (laboratory or field work) and data collection and analysis and hypothesis	2 months	CLO1 CLO2
6.	Justification of the project, final thoughts, research ethical recommendations, guidelines against plagiarism and future study directions	15 days	CLO3
7.	Report preparation, submission and presentation of project work.	1 months	CLO3

Assessment Strategy		Bloom's Category	Marks (Out of 100)						
Attendance	5%		5-10%	Remember	Understand	Apply	Analyze	Evaluate	Create
Evaluation	20%		5-10%						
Presentation/ Viva	25%		10-15%						
Project Report	50%		25-35%						
Total	100%		20-30%						

Learning References:

1. Handbook of Research Methodology: A Compendium for Scholars & Researchers edited by Dr. Shanti Bhushan Mishra Dr. Shashi Alok, ed., 2011, Educreation publishing, India.
2. Handbook of Research Methodology: Methods and Techniques edited by C. R. Kothari, Ed (2nd), 1990, New Age International Ltd., India.
3. An Introduction to the Theory of Statistics—R. N. Shil
4. Scientific articles of related study field.

Course Code	0916-418
Course Title	Bio-pharmaceutics Lab
Year & Semester	4th Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Bio-pharmaceutics Lab is designed to impart knowledge and skills of bio-pharmaceutics and pharmacokinetics and their applications in pharmaceutical development and in solving the quality problems raised therein. Manufacturing technology and pharmaceutical technical testing of the products are essential parts of the course together with bio-pharmacy related to absorption from the gastro-intestinal tract. The course also includes the basic principles of quality assurance.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the quality evaluation of various dosage forms in-vivo and in-vitro pathway.
CLO2	Demonstrate the factors that influence the quality of pharmaceutical preparations and their packaging materials based on biopharmaceutics and pharmacokinetics properties.
CLO3	Develop some basic knowledge and understanding of principles for modified release and dissolution (release) testing of solid oral dosage forms, sterile products and knowledge of personalized dosage forms.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓	✓				
CLO2	✓	✓	✓	✓		✓	✓	
CLO3	✓	✓	✓	✓			✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Determination of weight variation, hardness and friability of solid dosage forms	4 hrs	CLO1
2.	Disintegration test of solid dosage forms	4 hrs	CLO1
3.	Determination of packaging integrity (Leak Test) of tablets/ capsules/parenteral products	4 hrs	CLO2
4.	Dissolution study of uncoated tablet	6 hrs	CLO3
5.	Determination of coating integrity of enteric coated tablet in Gastric Simulated Fluid (GSF)	6 hrs	CLO1
6.	Dissolution study of enteric coated tablet in Intestinal Simulated Fluid (ISF)	4 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture							
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								
				Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Applied Biopharmaceutics and Pharmacokinetics – Leon Shargel
2. The Theory and Practice of Industrial Pharmacy- Lachman.

Course Code	0916-419
Course Title	Molecular Biology and Biotechnology Lab
Year & Semester	4th Year 1st Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

This course has been designed to provide the students with hand on training in various analytical and instrumental operations to get them skilled in solving different biochemical, clinical, and immunological problems. This course actually contains some laboratory works related to theoretical knowledge.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Prepare different types of media maintaining the aseptic condition inside the laboratory and to study different bacteria and fungi through microbial assay.
CLO2	Analyze and evaluate the different electrophoretic techniques and molecular tools in clinically important biological samples and interpret the obtained data.
CLO3	Develop skills to analyze and assay different biomolecules such as DNA, RNA for future research and improvement of pharmaceutical products.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓					✓
CLO2	✓	✓		✓	✓			✓
CLO3	✓		✓			✓	✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Isolation of plasmid DNA	4 hrs	CLO1, CLO2
2.	Isolation of chick cell DNA	4 hrs	CLO1, CLO2
3.	Estimation of DNA	4 hrs	CLO1, CLO2
4.	Estimation of RNA	4 hrs	CLO1, CLO2
5.	Agarose-gel electrophoresis of nucleic acid	4 hrs	CLO1, CLO2
6.	Determination of bacterial drug resistance by disk diffusion method	4 hrs	CLO3
7.	Determination of antibacterial activity from plant extract	4 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category Remember Understand Apply Analyze Evaluate Create						
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Text book of biochemistry: West and Tood.
2. Biochemical reaction mechanism: Ingram
3. The nucleic acids: Chargoff and Davidson.

Course Code	0916-421
Course Title	Hospital and Community Pharmacy
Year & Semester	4th Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

This course provides well-structured guide to making differential diagnosis for different body system carried out by the hospital and community pharmacist and the accordingly the medicine to be used which are suitable to different patient category and age group. Hospital pharmacy deals with procurement, storage, compounding, dispensing, manufacturing, testing, packaging and distribution of drugs in a hospital. It is also concerned with education and research in pharmaceutical services.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Analyze the plan, organize and implement pharmacy policy procedures in keeping with the established policies of the hospitals. Apply knowledge on drug therapy and the use of medication for the benefit of the patients.
CLO2	Evaluate the pharmacy practices such as compounding and dispensing of medications and also more modern services related to health care, including clinical services, reviewing medications for safety, efficacy and drug information.
CLO3	Create knowledge by depending on information provided from the patient because the community pharmacist should learn how to make differential diagnosis and how to discriminate between disease condition which could be treated by pharmacist and those that should be referred.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓				✓		✓
CLO2	✓	✓		✓		✓		✓
CLO3	✓	✓	✓		✓	✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Hospital pharmacy: a) Introduction: Goals, minimum standards, abilities required for a hospital pharmacist. Hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital. Hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job descriptions.	6 hrs	CLO1
	b) Pharmacy and Therapeutics committee: Description and purpose, membership and functions. Hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text.	3 hrs	CLO2
	c) Investigational use of drugs: Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee	3 hrs	CLO2
	d) Purchasing and Inventory control: Purchasing agent, purchasing procedure, control on purchases, storage, perishable inventory, physical inventory, perpetual inventory.	3 hrs	CLO1

	e) Control of special classes of drugs: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, el symbols. Narcotics and their control, classes, procurement and execution of order forms, dispensing, hospital narcotic regulations, new systems. Floor stock drugs, selection, charge and non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.	6 hrs	CLO2
	f) Dispensing to In and Outpatients: Drug distribution systems, dispensing of charge, non- floor stock drugs, mobile dispensing unit, unit dose dispensing, new concepts. Dispensing to Outpatients, locality of out-patient dispensing area, dispensing routine, record keeping. Dispensing during off-hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call. Drug charges in hospitals, pricing, break- even point pricing.	3 hrs	CLO2
	g) Manufacturing-bulk and Sterile: Control and budget, manufacturing facility and capacity, operating costs, quality control.	3 hrs	CLO2
	h) Drug information centre and Library: Physical facilities, selection of contents, methods of dissemination, role in educational and training programs, professional education, internal teaching programs, external teaching programs.	3 hrs	CLO3
2.	Community Pharmacy: Concept of community health care, health needs of the community, different levels of health care, elements of primary health care. Principles of primary health care: Equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies.	9 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Hospital Pharmacy - W.E. Hassan
2. A Textbook of Hospital and Clinical Pharmacy - Pratibha Nand and R.K. Khar
3. Hospital and Clinical Pharmacy - Anees Ahmed Siddiqui and M. Ali
4. Textbook of Community Medicine and Public Health - Rashid, Khabiruddin and Hyder
5. The Essentials of Community Medicine - Selim Reza
6. Textbook of Preventive and Social Medicine - K. Park
7. Remington's The Science and Practice of Pharmacy - A. R. Gennaro

Course Code	0916-422
Course Title	Clinical Pharmacy and Disease Management
Year & Semester	4th Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Clinical Pharmacy and Disease Management is a branch of Pharmacy that revolves around the preparation and the dispensing of drugs safely to the patients. This branch of Pharmacy takes care of safety in the production of pharmaceutical drugs and their safe use. Clinical pharmacists are responsible for providing the medication therapy and recommendations to the patients according to their needs. They are the experts in the therapeutic use of medications and are often responsible for providing information and advice regarding the safe use of pharmaceutical drugs.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Obtain medication history interview, counsel the patients and can identify and resolve drug related problems and provide drug therapy of patient through medication chart review and clinical review.
CLO2	Retrieve, analyze, interpret, and formulate drug or medicine information and understand the principles of toxicology and treatment of poisoning.
CLO3	Detect, assess, and monitor adverse drug reaction and interpret selected laboratory results of specific disease states.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				✓
CLO2		✓	✓		✓			
CLO3		✓			✓			

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Clinic, hospital, clinical pharmacy, scope, importance and application of clinical pharmacy, diagnosis & routine tests for diagnosis, enzyme, coenzyme & isoenzyme, and their role in diagnosis of disease, pharmacokinetics of few drugs.	6 hrs	CLO1
2.	Drug abuse and its effect: Drug abuse, drug addiction, drug habituation, drug dependence and drawbacks of self-medication.	3 hrs	CLO3
3.	Clinical chemistry & interpretation of clinical laboratory tests a) Blood chemistry b) Hematology c) Urinalysis	6 hrs	CLO1 CLO2 CLO3
4.	Case study, clinical interpretation and disease management of the following diseases a) Diabetes b) Essential hypertension c) Heart diseases (Myocardial infarction, congestive cardiac failure etc) d) Tuberculosis e) Anemia f) Neoplasia g) Neurological disorders h) Liver cirrhosis i) Infectious diseases (AIDS, COVID-19, influenza, gonorrhea, dengue etc.)	18 hrs	CLO1 CLO2 CLO3
5.	Effects of Poisons: Poisons, toxins of animal origin, role of poison centers, adverse reactions and poisoning incidences analysis of poisoning situations, sources and assessment of poison exposure, over doses of drugs and drug interactions, symptoms and management of poisoning cases with pesticides, fumigants, solvents, vapors, food toxins and cyanides.	3 hrs	CLO3

6.	Drugs adverse effects and Pharmacovigilance: a) Principles, evaluation in animals, determination of LD10, LD50, ED50, therapeutic index, etc. b) Adverse reactions, causes of adverse reactions, factors affecting side effects of drugs. c) Drug allergy, tests for prediction of drug allergy.	6 hrs	CLO1 CLO3
----	--	-------	--------------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. A Textbook of Hospital and Clinical Pharmacy - Pratibha Nand and R.K. Khar
2. Hospital and Clinical Pharmacy - Anees Ahmed Siddiqui and M. Ali
3. Clinical Biochemistry - J. Marshal and K. Bangert
4. Remington, The Science and Practice of Pharmacy - A. R. Gennaro
5. Applied Therapeutics - Lloyd Y. Young and M.A. Koda
6. Forensic Pharmacy and Ethics - S.C. Sahajan and J. B. K. Narang
7. Textbook of Forensic Pharmacy - B. M. Mithal.

Course Code	0916-423
Course Title	Pharmaceutical Technology-III
Year & Semester	4th Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical Technology is a major requirement module which has a reflective, interactive, and analytical contextual focus. This will provide a comprehensive and sound understanding of the theory and practice of pharmaceutical technology and to appreciate the various processes; batch or continuous, those are available. The importance of the technology process in producing good quality products will be emphasized. The course will examine current compression about theory in details. The course will discuss the basic concepts of pharmaceutical formulation.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Understand the scientific principles and technologies involved in the design, formulation, manufacturing, and quality assurance of advanced pharmaceutical dosage forms and packaging systems.
CLO2	Apply knowledge of cleanroom technology, aseptic manufacturing, and quality control practices to ensure contamination-free production of sterile and ophthalmic pharmaceutical products.
CLO3	Evaluate and implement modern pharmaceutical packaging and safety systems to protect drug products from contamination, tampering, and environmental damage.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓			✓	✓
CLO2	✓	✓	✓	✓	✓	✓		
CLO3	✓	✓	✓	✓			✓	✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Compaction and compression of powder: Physics of tablet compression, different stages of tablet compression, effect of compression force on tablet properties, strength of tablet, factors affecting the strength of tablet, mechanism of bonding to tablets, problems associated with large scale manufacturing of tablet.	7.5 hrs	CLO1
2.	Sustained release drug delivery systems: Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form	7.5 hrs	CLO1
3.	Aerosol science and technology: Definition and classifications of aerosols, advantages and disadvantages of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, systems of aerosol, container, valves and actuators for aerosols, manufacturing of aerosols, testing and quality assurance of aerosols.	6 hrs	CLO1 CLO3
4.	Design and operation of clean rooms: Source of contamination, classification of clean rooms, air flow systems conventional flow, unidirectional flow, laminar air flow units, air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction and use, personnel, protective clothing, cleaning and disinfection, commissioning tests of clean and aseptic rooms, routine monitoring tests, the operation of clean and aseptic rooms, key factors in clean room operations	7.5 hrs	CLO2

5.	Parenteral and ophthalmic products: Definition and classification of parenteral products, purified water and water for injection, formulation considerations, vehicles and additives, containers, manufacturing consideration, environment, manufacturing techniques, raw materials and machines, quality control of parenteral products, anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, formulation, vehicles and additives, manufacturing consideration, environment, manufacturing techniques, quality control of ophthalmic products.	6 hrs	CLO1 CLO2
6.	Tamper resistant packaging and child resistant packaging: Definition, history of tamper-evident packaging, regulatory aspects of tamper-evident packaging, anti-tampering regulation, importance of tamper resistant packaging and child resistant packaging, tamper resistant packaging requirement for OTC human drug products, various technologies for making a package tamper evident, reducing the risk of product tampering agents.	3 hrs	CLO3
7.	Desiccants used in pharmaceutical packaging: Definitions, types of desiccants, desiccant sachets, a general comparison of desiccant properties, a general comparison of properties of sachet materials, importance and application of desiccant in pharmaceutical industry, safety requirements of desiccants.	1.5 hrs	CLO3
8.	Testing and quality assurance of packaging materials: Leakage detection in sterile products (ampoules, vials), leakage test (bubble point test for strip and blister packet).	3 hrs	CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)	10-20%	10-20%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate
	Class test/ Quiz/Viva/ Case study	10%							
	Assignment/ Presentation	5%							
	Midterm Exam	30%							
	Final Exam	50%							
	Total	100%							

Learning References:

1. The theory and practice of Industrial Pharmacy- L. Lachmann, H. A. Liberman.
2. American Pharmacy- Sprowl
3. Pharmaceutics- M. E. Aulton
4. Remington, The Science and Practice of Pharmacy - A. R. Gennaro
5. Dispensing for Pharmaceutical Students- Cooper & Gunn
6. Dispensing of medication- Husa& Martin
7. Bentley's Textbook of Pharmaceutics
8. Tutorial Pharmacy- Cooper & Gunn
9. An introduction to Pharmaceutical Formulations- Fishburn.
10. Pharmaceutical dosage form and Drug delivery systems- H. C. Ansel and N. G. Popovich.
11. Pharmaceuticals Packaging Technology - D.A. Dean, E.R. Evans, I.H. Hall
12. Guidelines on packaging for pharmaceutical products (World Health Organization WHO Technical Report Series, No. 902, 2002)

Course Code	0916-424
Course Title	Cosmetology
Year & Semester	4th Year 2nd Semester
Course Credit	2
Credit Hours	28
Total Marks	80

Course Description:

This course introduces the knowledge of cosmetic products. In this course, students will learn the anatomy of the skin and hair, their functions, and relevant care preparations. Furthermore, students will study the most effective cosmetic active ingredients and their medical effects on skin and hair. Also, students will recognize the inactive ingredients for the preparation of cosmetic formulations. Moreover, students will learn the most important regulations for good manufacturing practice of cosmetic products

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the concept of cosmetic and dermatologic preparation, active ingredients used in cosmetic products formulations, design cosmetic products which will be applied to hair, skin.
CLO2	Analyze the interaction between skin biochemistry and cosmetic formulations, issues of toxicity, skin irritation and allergy in regard to cosmetic formulations.
CLO3	Evaluate and implement compliance, regulatory and safety requirements in regards to cosmetic formulations.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓				
CLO2	✓	✓			✓			
CLO3					✓	✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Cosmetology, cosmetics, classification and properties of cosmetics	2 hrs	CLO1
2.	The skin: Skin, function of skin, different layers of skin, epidermis and keratinizing system, pigmentary system, langerhans cell, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands	4 hrs	CLO1

3.	Disorders of skin: Acne, bed sores, corns and calluses, dry skin, keratosis pilaris, pityriasis rosea, psoriasis, rosacea, impetigo, scabies, pediculosis, ringworm, eczema, leprosy, skin cancer.	4 hrs	CLO1 CLO2 CLO3
4.	Skin cream: Introduction, function and classification of skin creams, cold cream, vanishing creams, cleansing cream, and lotion, formulation and manufacturing procedure of cold cream and vanishing cream, packaging and labeling of cream.	4 hrs	CLO1 CLO2 CLO3
5.	Shaving preparation: Introduction, lather shaving cream, brushes less or non-lathering cream, aerosol shaving foams, after shave preparations.	3 hrs	CLO1 CLO2 CLO3
6.	Dental products: Physiology of teeth, dental carries dental plaque, calculus, dentifrices, formulation and manufacture of toothpastes, tooth powder and mouth-wash, quality control of dentifrices, packaging of dentifrices.	4 hrs	CLO1 CLO2 CLO3
7.	Hair products: Shampoos, function and classification of shampoo, composition of shampoo, formulation and evaluation of shampoo, hair conditioner, hair tonic etc.	3 hrs	CLO1 CLO2 CLO3
8.	Lip-products: Lipstick, characteristics, composition, and preparation of lipstick.	2 hrs	CLO1 CLO2 CLO3
9.	Brief study on antiperspirant and deodorant.	2 hrs	CLO1,CLO2

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%

Learning References:

1. Cosmetics Science and Technology (Vol. 1 & II) - M S balsam, E. Sagarin
2. Preparation and Distribution of Drugs & Cosmetics - S. N Sa

Course Code	0916-425
Course Title	Pharmaceutical Management
Year & Semester	4th Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Pharmaceutical Management combines the study of basics of pharmaceutical sciences with management studies. This course is for preparing students' careers in pharmaceutical management, sales and other fields related to healthcare industry. It also increases students' skills in planning & operating management techniques, acquiring consultancy skills and solving management problems.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe management, levels and functions of management and importance of supply chain management with its implementation.
CLO2	Analyze modern materials & sales management systems with proper planning and relatable distribution network.
CLO3	Develop innovative customer-focused new products and services.
CLO4	Correlate corporate, ethics and society based on good customer service by effective human resources.
CLO5	Evaluate all major management concepts and how to apply the concepts in pharmaceutical sectors.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1		✓	✓			✓		
CLO2	✓	✓				✓		
CLO3			✓				✓	
CLO4	✓				✓			✓
CLO5		✓	✓			✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
	Introduction and supply chain management: Characteristics and importance of management, levels of management, function of management, concepts of supply chain, tasks of supply chain, strategic role of supply chain, challenges facing supply chain managers.		
2.	Materials management: Formulating buying policies, determining needs of materials, sourcing materials, receiving and stocking materials, management of supply bases, value chain analysis and alliance network development.	6 hrs	CLO2
3.	Inventory management: Production planning, managing the flow of materials to production cost of inventory, methods of inventory control, selection of optimum method, effect of inventory control, economic order quantity, just in time, optimization production technology.	6 hrs	CLO2 CLO5
4.	Distribution& developing cost effective transportation: Components of distribution organization, establishing distribution network, measuring the effectiveness of distribution network, management of community pharmacy and governmental pharmacy. Transport mode selection, designing optimum transportation system.	6 hrs	CLO2
5.	Managing sales force: Recruiting, training, motivating and evaluating sales force. Sales planning, organizing sales, assigning sales territory, sales analysis.	3 hrs	CLO2 CLO3
6.	Customer service: Order cycle, financial consideration, technical and logistical support.	3 hrs	CLO3 CLO4
7.	Entrepreneurship, entrepreneurial process & motivation: Definition, evolution of entrepreneurship, role in the economic development, qualities of entrepreneurs, entrepreneurial education and career in pharmaceutical industry, social and ethical responsibilities of entrepreneurs. Decision making, factors affecting entrepreneurial growth in pharmaceutical industry, legal issues related to entrepreneurship in pharmaceutical industry. Entrepreneurial feelings, motivation and role model support system for entrepreneurship development in pharmaceutical industry.	6 hrs	CLO3 CLO4

8.	Business idea development planning: Creativity and business idea, sourcing and generating idea, creative problem-solving techniques, refining business idea, new product planning & development process. Venture opportunity scanning in the pharmaceutical industry, marketing plan, financial plan and organizational operation plan.	3 hrs	CLO3 CLO4
9.	Human resource management: Scope, importance, recruiting, training, motivating, industrial relations.	3 hrs	CLO4 CLO5

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Pharmaceutical Industrial Management – R M Mehta
2. Introduction to Supply Chain Management - Handfield R Robert
3. Introduction to Materials Management- J. R. Tony Arnold
4. Managing the Global Supply Chain - Philip B Schary
5. Strategic Physical Distribution Management - Douglas M Lambert
6. Introduction to Sales Management - H R Tesdal
7. Entrepreneurship Development - Hisrich, Robert D & Peters Michael P
8. Entrepreneurship Development - Khanka S S.

Course Code	0917-426
Course Title	Functional Foods, Nutraceuticals and Herbal Medicines
Year & Semester	4th Year 2nd Semester
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

Functional foods and nutraceuticals are products derived from food sources that are purported to provide extra health benefits, in addition to the basic nutritional value found in foods. These products claim to prevent chronic diseases, improve health, delay the aging process, increase life expectancy, or support the structure or function of the body. Specifically, the course is aimed to provide basic knowledge on the digestion, absorption, metabolism and biological/functional activity of the different macronutrients (carbohydrates, fats, proteins) micronutrients (vitamins and minerals), and nutraceuticals/bioactive compounds (e.g. carotenoids, glucosinolates etc.). It also teaches students about basic phytopharmacology, herbal medicine, manufacturing practices and dietary regulations of functional foods and nutraceuticals.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Explain the scientific basis, bioactive components, and health-promoting roles of functional foods, nutraceuticals, and herbal medicines.
CLO2	Analyze the physiological and therapeutic effects of bioactive compounds from foods and herbs in the prevention and management of chronic diseases
CLO3	Evaluate the safety, efficacy, and regulatory aspects of nutraceuticals and herbal medicine, and apply this knowledge in practical or research contexts.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓			✓		✓	✓	✓
CLO2	✓			✓		✓	✓	✓
CLO3		✓	✓	✓	✓	✓		✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Introduction: Definition, history, types and classification of functional foods and nutraceuticals, perceived effect of diet on disease prevention, understanding benefits of functional foods and nutraceuticals	3 hrs	CLO1
2.	Food Components and Nutrition: Food composition, macronutrients, micronutrients, protein, carbohydrates, fats and oils, vitamins, minerals, dietary fibers and fiber like ingredients, trans fatty acids and omega 3,6,9 fatty acids, sugar and fat substitutes.	4.5 hrs	CLO1
3.	Nutrition, Functional Foods and Health: a) Relationship of nutrition and health, dietary guidelines/food pyramid, Mediterranean diets. b) Functional foods for immune system, brain development and obesity.	7.5 hrs	CLO1 CLO2
4.	Nutraceuticals: Nutraceuticals in herbal products, fruits, vegetables and grains, effect of nutraceuticals on cancer, immune system, phytochemicals and their role in prevention of specific diseases, Antioxidant, antidiabetic, anti-inflammatory and hypolipidemic herbs and nutraceuticals.	6 hrs	CLO1 CLO2
5.	Probiotics and Prebiotics: a) Probiotic strains, Functional properties of probiotics, medical applications of probiotics, selection of probiotic strains, probiotic food categories. b) Prebiotics, criteria of prebiotic components, health benefits of prebiotics, symbiotic.	7.5 hrs	CLO3
6.	Food Products Development and Food Biotechnology: a) Technologies for functional food manufacture, microencapsulation, nanoencapsulation of food ingredients in cyclodextrins and emulsion delivery systems for functional foods. b) Food Biotechnology: Food biotechnology in fermented dairy products, starter culture, yogurt, cultured butter milk, acidophilus milk and kefir.	6 hrs	CLO3

7.	Quality Assurance of Nutraceuticals, Dietary Supplements and Herbal Products: a) GMPs, hazard and risk analysis, quality factors, toxicity analysis, shelf life of nutraceuticals, functional foods and dietary supplements, bioavailability and safety issues of functional foods and nutraceuticals. b) Quality control of herbal drugs: safety & toxicity profile, development of standardization parameters, extraction, pharmacological screening, quality assurance and stability study of herbal drugs.	7.5 hrs	CLO3
----	---	---------	------

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Functional Food Product Development, Edited by Jim Smith and Edward Charter
2. Functional Foods and Dietary Supplements: Processing Effects and Health Benefits, Edited by Athapol Noomhorm, Imran Ahmad and Anil Kumar Anal
3. Probiotics and Health Claims Edited by Wolfgang Kneifel and Seppo Salminen
4. Dairy Ingredients for Food Processing Edited by Ramesh C. Chandan and Arun Kilara
5. Bioactive Proteins and Peptides as Functional Foods and Nutraceuticals: Yoshinori Mine, Eunice Li-Chan, and Bo Jiang
6. Functional Foods: Designer Foods, Pharmafoods, Nutraceuticals: Israel Goldberg
7. Advances in Natural Medicines, Nutraceuticals and Neurocognition: Con Kerry Kenneth Stough, Andrew Scholey
8. Handbook of Nutraceuticals and Functional Foods: Robert E.C Wildman.

Course Code	0916-427
Course Title	Pharmaceutical Technology-III Lab
Year & Semester	4th Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

Pharmaceutical technology is a field of medicine which deals with preparation, dosage, and side effects of different medicines. The course provides the students with basic knowledge on the manufacturing process and different machines used in the production of the tablets of any medicine.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Relate the physicochemical properties of drugs to dosage form characteristics.
CLO2	Operate different equipment's used in preparation of dosage forms.
CLO3	Compare different types of solid, liquid, semisolid dosage forms, different additives & conventional and advanced manufacturing techniques.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓							✓
CLO2	✓	✓	✓		✓			
CLO3	✓	✓	✓		✓			✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Preparation and Compounding of Paracetamol Tablets	4 hrs	CLO1 CLO2
2.	Preparation and Compounding of Metronidazol suspension	4 hrs	CLO1 CLO2
3.	Preparation and Compounding of Ointment	4 hrs	CLO1
4.	Preparation and Compounding of effervescent Tablet	4 hrs	CLO2 CLO3
5.	Physical evaluation of Tablets and suspension: DT, Hardness, Viscosity for suspension	4 hrs	CLO3
6.	Study of different types of Binder used in tablet formulation and evaluation after compression	4 hrs	CLO2
7.	Leak test of Packaging of tablet and capsule	4 hrs	CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Dispensing of medication - Husa& Martin
2. Pharmaceutical dosage form and Drug delivery systems - H. C. Ansel and N. G. Popovich.
3. An introduction to Pharmaceutical Formulations - Fishburn.

Course Code	0916-428
Course Title	Cosmetology Lab
Year & Semester	4th Year 2nd Semester
Course Credit	1
Credit Hours	28
Total Marks	100

Course Description:

The major persistence of cosmetology course is to train the student in the basic skills, safety judgments, proper work habits and desirable attitudes necessary to obtain desired pharmaceutical products. Many cosmetics are made with the incorporation of medicaments such as antifungal shampoo, cream, lotion, soap etc. Students will achieve the profound knowledge in manufacturing those products which meet the quality specifications.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Prepare quality cosmetics products and solve the arising problems during manufacture.
CLO2	Maintain PH of the cosmetics products which is very crucial parameter for topical use.
CLO3	Apply theories, principles, and concepts to learn additional skills needed as a pharmacist.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1				✓	✓			
CLO2	✓				✓			✓
CLO3	✓		✓			✓		

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Preparation of hard soap	4 hrs	CLO1
2.	Preparation of soft soap	4 hrs	CLO2
3.	Preparation of leather saving cream	4 hrs	CLO3
4.	Preparation of shampoos	4 hrs	CLO1 CLO2 CLO3
5.	Preparation of lotion	4 hrs	CLO3
6.	Preparation of vanishing cream	4 hrs	CLO2
7.	Preparation of cold cream	4 hrs	CLO1

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of experiment & overview Question-Answer session Text books Laboratory manual Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Evaluation	15.5%								
	Experiments	33%								
	Experiment Result	15.5%								
	Report/khata	15.5%								
	Viva voce	15.5%								
	Total	100%								

Learning References:

1. Cosmetics Science and Technology (Vol. 1 & II) by M S balsam, E. Sagarin
2. Preparation and Distribution of Drugs & Cosmetics by S. N Saha.

Course Code	0916-429
Course Title	Oral Assessment-IV
Year & Semester	4th Year 2nd Semester
Course Credit	1
Credit Hours	15
Total Marks	100

Course Description:

An oral assessment is a direct means of evaluating students' knowledge by questioning them. Oral assessment does not usually have a planned list of questions; evaluators ask questions and request answers depending on the circumstances. By doing this, evaluators receive immediate reactions and responses with no plagiarism or false reports.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Demonstrate verbally the depth of understanding, thinking and problem-solving ability.
CLO2	Interact with courage and spontaneity beyond nervousness in face to face interview.
CLO3	Present their concepts systematically in oral form and exhibit preparedness for future job interview.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1			✓	✓			✓	
CLO2			✓			✓	✓	
CLO3			✓			✓	✓	

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	All courses of 6 th semester	15 hrs	CLO1 CLO2 CLO3

Teaching- Learning Approach	Assessment Strategy		Positive Reinforcement Tasks
Discussion of lecture Overview of courses Question-Answer session Text books PowerPoint lecture notes Websites Videos/Documentaries Scientific articles	Attendance	10 %	Feedback/Response Individual discussion Group discussion Misconception check Summarization of lecture
	Viva (Attire, Attitude, Speaking, Knowledge)	90 %	
	Total	100%	

Learning References:

1. All textbooks of this semester

Course Code	0916-430
Course Title	In-plant Training (Industrial and Hospital/Model Pharmacy)
Semester	4th Year 2nd Semester
Course Credit	2

Course Description:

During the fourth year, students will participate in an in-plant training program within both pharmaceutical industries and hospitals/model pharmacies. In accordance with the policies of the respective organizations, the total training duration will be four (04) weeks. Each placement—pharmaceutical industry and hospital/model pharmacy—must cover a minimum of one (01) week. Upon completion of the training, students are required to submit a comprehensive report covering the entire training experience. This report will be evaluated by both internal and external examiners from the relevant fields. Following the submission, students will deliver a presentation and undergo a viva voce examination based on their training report.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Drive their own learning into collaboration to serve as a solution of many problems and help companies for production of pharmaceutical products under the strictest manufacturing standards.
CLO2	Ensure equitable access to essential medicines, vaccines and technologies, and their appropriate use is a core function of the health system.
CLO3	Research, develop, market and/or distribute drugs, most commonly in the context of healthcare.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓		✓			✓		✓
CLO2					✓			✓
CLO3	✓		✓	✓	✓			

Assessment Strategy of Industrial and Hospital/Model Pharmacy Training:

Training report evaluation	60%
Presentation and Viva	40%
Total	100%

Only for the students who did not take Mathematics in the HSC examination

Course Code	0541-511
Course Title	Basic Mathematics
Course Credit	3
Credit Hours	42
Total Marks	100

Course Description:

It develops mathematical curiosity and use inductive and deductive reasoning when solving problems. By this course the students will become confident in using mathematics to analyze and solve problems both in educational institute and in real-life situations. It also develops the knowledge, skills and attitudes necessary to pursue further studies in mathematics.

Course Learning Outcomes (CLOs):

CLO No.	Expected Course Outcomes Upon completion of this course, the students will be able to:
CLO1	Describe the world and provides an effective way of building mental discipline.
CLO2	Develop logical reasoning, critical thinking, creative thinking, abstract or spatial thinking, problem-solving ability, and even effective communication skills.
CLO3	Develop analytical skills.

Mapping of Course Learning Outcomes to Program Learning Outcomes:

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	✓	✓		✓				✓
CLO2		✓	✓		✓			
CLO3	✓	✓		✓				✓

Course Plan:

S.N.	Contents of Course	Credit Hours	Aligned to CLOs
1.	Algebra: a) Fundamental theorem of algebra, relation between roots and coefficients, descartes rule of signs. b) Logarithm and exponential theorem c) Complex numbers and their properties d) Arithmetic and geometric progression	14 hrs	CLO1 CLO2 CLO3
2.	Differential and integral calculus a) Functions: Domain, range, inverse and graphs of functions, limits, continuity and differentiability, indeterminate forms. b) Ordinary differentiation: Differentiation, successive differentiation. c) Expansions of functions: Rolle's Theorem, Mean value theorem, Taylor's and Maclaurin's formulae. d) Indefinite integrals: Method of substitution, integration by parts, special trigonometric functions, and rational fractions. e) Definite integrals: Fundamental theorem, general properties, evaluations of definite integrals and reduction formulas.	18 hrs 40 mins	CLO1 CLO2 CLO3
3.	Coordinate geometry a) Co-ordinates, polar co-ordinates b) The straight line, pair of straight lines c) Circles, system of circles	9 hrs 20 mins	CLO1 CLO2 CLO3

Teaching-Learning Approach	Assessment Strategy		Positive Reinforcement Tasks	Marks (Out of 100)						
					10-20%	10-20%	20-30%	20-30%	20-30%	20-30%
Discussion of lecture & overview Question-Answer session Text books PowerPoint lecture notes Websites Videos/ Documentaries Scientific articles	Attendance	5%	Feedback/ Response Individual discussion Group discussion Misconception check Summarization of lecture	Bloom's Category	Remember	Understand	Apply	Analyze	Evaluate	Create
	Class test/ Quiz/Viva/ Case study	10%								
	Assignment/ Presentation	5%								
	Midterm Exam	30%								
	Final Exam	50%								
	Total	100%								

Learning References:

1. Hall and Knight: Higher Algebra
2. Bernard and Child: Higher Algebra
3. B. C. Das and B. N. Mukherjee: Differential Calculus, U. N. Dhur& Sons
4. B. C. Das and B. N. Mukherjee: Integral Calculus, U. N. Dhur& Sons
5. Joseph Edwards: Differential Calculus, Kessinger Publishing

Part D – Assessment & Evaluation

The assessment and evaluation will undoubtedly be transparent. The performance of the students is evaluated throughout the semester.

Some important points of the ordinance of B. Pharm. (Honours) degree at Varendra University:

18. Admission

There are two semesters in every year (Summer and Spring) for B. Pharm. (Honours) program. Admission for 1st semester is open in every semester. Notice for admission will be published in university website as well as different national dailies.

19. Admission Requirement

Students seeking admission for the degree of Bachelor of Pharmacy must have a total GPA 8.00 (out of scale of 10) in both the SSC/equivalent & HSC/equivalent examinations (Individually at least 3.50 out of scale 5) from Science group and must have minimum GPA 3.5 (out of scale 5) in Chemistry and Biology and GPA 3.0 (out of scale 5) in Physics and Mathematics separately in both examinations. But students having no Mathematics in HSC/A level/equivalent examinations can be admitted but they will need to take an extra 3 (three) credits course on Mathematics during B. Pharm. (Honors) candidature at Varendra University. For A level, students must have a minimum B Grade in Chemistry and Biology and a minimum C Grade in Physics and Mathematics. Candidates must complete the admission process within 3 years from the year of publication of HSC/equivalent examination result.

20. Academic Standards

Keeping the mission and goals in mind, the undergraduate program in pharmacy strives to ensure high academic standards by implementing well-designed curricula, carefully selecting high quality students and faculty, utilizing modern and effective instructional methods and aides, and by continuously monitoring and vigorously evaluating all the pertinent activities and systems. Special feature of teaching such as the tutorial/workshop sessions are designed to assist the students in learning application of the concepts and theories.

21. Award of Degree

Varendra University will award B. Pharm. (Honours) degree to the students completing the required credits with a minimum CGPA (Cumulative Grade Point Average) of 2.50 on a scale of 4.00. A required credit for B. Pharm. (Honours) degree is 160 as per the standard of International and Pharmacy Council of Bangladesh (PCB).

22. Examinations

The performance of a student in a theoretical course is estimated based on:

- a. Attendance
- b. Continuous assessment (class tests, class performance, quizzes, assignments, presentation)
- c. Mid-term Examination
- d. Semester final examination
- e. Retake/Improvement examination (if any)

The performance of a student in a lab course will be based on attendance, class performance, practical examinations etc.

23. Grading System

The grading process will undoubtedly be transparent. The performance of the students is evaluated throughout the semester through class tests, quizzes, assignments, and midterm exams. End of semester evaluation includes final examinations, term papers, project reports etc. Numerical scores earned by a student in tests, examinations, assignments etc. are cumulated and converted to letter grades.

VU follows the following Letter Grade and Grade Point system introduced by the UGC as a uniform grading system for all public and private universities:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00

- The Letter Grade A+, A, A-, B+, B, C+, C and D are considered as pass grades.
- F grade is considered as 'FAIL' and in such cases students must go for retake.
- After completion of program, final transcript will be issued mentioning Letter Grade, Corresponding Grade Points, Attempted Credit, Earned Credit and CGPA.
- Numerical marks in Grade Sheet/Transcript will not be shown.

24. Calculation of GPA and cGPA

Suppose a student has completed five courses in a semester and obtained the following grades:

Courses	Credits	Grade	Grade Point
Course 1	3	A+	4.00
Course 2	3	B	3.00
Course 3	3	A	3.75
Course 4	2	B+	3.25
Course 5	1	A-	3.50

Then his/ her Grade Point Average (GPA) for the semester will be computed as follows:

$$\text{GPA} = \frac{3(4.00) + 3(3.00) + 3(3.75) + 2(3.25) + 1(3.50)}{(3 + 3 + 3 + 2 + 1)} = 3.52$$

Thus, GPA= Sum of (Grade Points x Credits)/ Sum of credits attempted.

$$\text{cGPA} = \frac{\text{Sum of (Earned Credit X Corresponding Grade Points)}}{\text{Total Credits}}$$

25. Required Class Attendance For the Examination

- a. Students are required to attend all lectures, tutorials, assignments, lab works etc., of the courses that they have registered in. 75% attendance is required of a student to be eligible to sit for the final examination.
- b. A student having 50% or more but less than 75% attendance will have to pay requisite amount of fine to appear at the final examination (Non collegiate). However, the Non-collegiate fee will not be applied for the semester-dropout students.
- c. A student attending less than 50% classes will not be allowed to sit for the final examination (Dis-collegiate).
- d. Course teacher will enter the attendance of the student before the final examination in the online database by due date as decided by the department.

26. Promotion

Promotion of the undergraduate and graduate students will be based on the individual semester result. For promotion to the next semester, a student needs to earn at least 50% of the total credits in the final examination. If the number of earned credits in a semester is a fraction figure, then the number of earned credits will be rounded up. (Example: If the number of total credits is 9, and the fraction figure of the earned credit is 4.5 or above, then the credit will be rounded up as 5).

27. Improvement

- a.** A student obtaining B-, C+, C and D grades in theory course only may improve the grade(s) by appearing in the midterm and final examinations or final examination. A student may improve above mentioned grade(s) along with regular courses. In case of improvement after passing all courses of the respective program, a student will be allowed once in the succeeding semester, but s/he has to take approval from the head/coordinator of the department.
- b.** For improvement and retake a student can take a maximum of 12 credits or 3 courses altogether within the succeeding two semesters.
- c.** To prepare the improvement results, the course teachers can only modify midterm and final examination marks of the students in the result automation process. Other marks (i.e., class test, assignment etc.) will be automatically generated by the software from the previous database.
- d.** A student will have to pay requisite fee of the per credit fees for the improvement of grades.
- e.** If an examinee fails to improve his/her result, the previous result in the software will stand.
- f.** If a student improves his/her course(s) after finishing normal duration of the program, s/he will pay only registration fee, exam fee and requisite fee for improve of course(s). If s/he fails again, no refund of fees will be made.

28. Retake

- a.** If a student obtains F grade(s) in any courses for any reason, s/he must retake the course(s) within the succeeding two semesters.
- b.** For retake and improvement, a student can take a maximum of 12 credits or 3 courses altogether within the succeeding two semesters.
- c.** If a student obtains F grade(s) after the end of the program, s/he will get a chance to complete the course (s) within additional 3 years after the end of his/her specific time of completing the degree. But in case of fail in Pre-Requisite course(s), the student must retake the course in the succeeding semester.
- d.** Except for Pre-Requisite course(s), a student can retake the course(s) at his/her convenient semester(s).
- e.** A retake student will complete all course curriculums (i.e. class attendance, class test, assignment etc.) including midterm and final examinations of the specific course(s). In special cases, if the student cannot attend classes or continuous assessment (i.e., assignment, class test etc.), previous marks can be accepted to calculate GPA.

29. Re-Admission

- a.** Students failing to get promotion to the next semester must seek Re-Admission (Re-Ad) within the stipulated time of his/her program.
- b.** Grades, other than F, obtained by a student in the preceding semester of re-admission will remain valid, and the student will have to repeat the courses in which s/he did not earn credit (if failed). Improvement (other than F) of any grades (B and lower) may be allowed.
- c.** The registration number of the student will remain the same.
- d.** Students will have to pay tuition fees only for repeated course (s). Also, s/he is to pay other fees (except development fees, as it is payable once for a semester).

30. Semester Drop & Cancellation of Admission

- a.** After getting enrolled for a semester, if any student fails to continue academic activities (i.e. class, exam, practical, assignment, presentation, etc.) up to the midterm examination, s/he will be considered as a semester drop student. In this case, s/he will not be allowed to sit for the final exam.
- b.** After getting enrolled for a semester, if any student completes all academic activities but fails to appear at the midterm examination, the student may be allowed to sit for the final exam.
- c.** A semester drop student may get readmission in the subsequent semester on payment of semester drop fee and his/her paid amount (full/partial) will be adjusted at the time of readmission. However, if any student discontinues the study forever, s/he will not get back the money paid at the time of admission.
- d.** In case of semester drop or withdrawal, a student will be considered as a fresh student for the semester. S/he will get all chances for improvement, retake and re-admission like a fresh student. However, a student must complete his/her program within the time mentioned in section 7 from the time of his /her first semester admission.
- e.** After cancellation of admission, If a student returns, s/he will be admitted to the same semester by paying the requisite fee (considered as semester drop student), but s/he must complete degree within stipulated time period.
- f.** If a student wants to cancel his/her admission, s/he should have to pay requisite fee for Admission Cancellation.

31. Academic Dismissal from the Program

- a.** If a student gets admitted by giving fake information.
- b.** If a student violates any of the university rules, regulations, code of conduct and examination rules.
- c.** VU reserves the right to suspend or expel any student from the university on valid grounds.

32. Co-curricular Activities

Students are encouraged to pursue some extra interests or activities in addition to academic study whenever possible.

a) Pharma Bee Club

Pharma Bee Club is the non-political and voluntary student organization and official students club of Pharmacy department. It was founded on 11 March 2014.

Motto: “The Hive of Smart Pharmacists”

Mission: To build up qualified pharmacists by giving a platform to the pharmacy students through which they will be able to participate in the activities of research and industrial works of the pharmaceutical world.

Activities of Pharma Bee Club

- Pharmacy oriented research
- Seminar and workshop on pharmacy profession
- Annual pharmaceutical expo.
- Annual publication
- Medical and IT oriented training program
- Free medicine distribution
- Free blood grouping and blood donation
- Semester based study tour
- Celebration of different national days and awareness campaign

- o National Mother Language Day- 21st February
- o National Independence Day – 26th March
- o Victory Day – 16th December
- o World Tuberculosis Day – 24th March.
- o World Health Day – 7th April.
- o World Environment Day – 5th June.
- o World Pharmacist Day Celebration – 25th September.
- o Antibiotic Awareness Week – 18-24th November
- o World Aids Day– 1st December.

b) Other Co-curricular activities

- Indoor games
- Football tournament
- Cricket tournament
- Badminton tournament
- Debating competition
- Writing, art& photography contest
- Cultural program

33. Alumni Association

1. Improving the image of the Department of Pharmacy as well as Varendra University.
2. To establish unity, harmony and brotherhood among the students and also with alumni.
3. To help and support each other as much as possible.
4. To protect the interests of students.
5. Establishing a separate fund for the assistance of eligible students.
6. Organize orientation program, assembly, seminars, symposiums, workshops, exhibitions and amusement tours for students.
7. Regularly publishing 'bulletins', periodicals, books and publishing different publications.
8. To organize social, cultural, sports and other events.
9. Cooperation in the development of educational environment of the Department of Pharmacy.
10. To undertake various programs for the development of education.

34. Library Rules and Regulations

Students, Faculty Members and Officers/Employees of the University shall adhere to the following rules regarding the use of the library and its resources:

A. What facilities will users get in VU Library / What users can do in the VU library:

1. After entering the library, students will place their bags and essentials in designated areas in charge of security and students will sit in an orderly manner in the library with tokens.
2. Students will keep their mobiles, laptops or other belongings under their own responsibility. Library authority will not be responsible if lost.
3. Students will keep mobile phones on silent mode in the library and always speak calmly.
4. A student may take 3 books for maximum of 10 days.
5. A teacher may take 5 books for maximum period of 1 month.
6. A general user (officer/employee) may take 3 books for maximum period of 1 month.
7. A teacher, student or general user must return the book within the prescribed period.
8. If there are more than 2 copies of a book in the library, the student may take or photocopy the book.
9. If any teacher, student or general user loses any book, he/she will be obliged to bring the corresponding book. (Photocopy, if photocopy and original copy, if original)
10. Library staffs should be courteous with the library users.

B. What facilities users will not get in VU Library/ What users can't do in the VU library:

1. Gossiping, talking loudly, laughing or eating food is strictly prohibited inside the library.
2. No student can enter the library with his own books. However, students can enter the library with notebooks, pens or any valuables.
3. Books cannot be issued to any teacher, student or general user (officer/employee) without VU ID card.
4. Authorities will take necessary action if there is evidence of issued books page cutting, page tearing, marking, underlining, book cover torn, book lost, book stolen etc.
5. Students can use laptops or mobile phones only for educational purposes in the library. Others, such as Facebook, movies, games, listening to music, etc. are not allowed.
6. Appropriate action will be taken for any unexpected behavior in the library premises by library users.
7. The reading room shall abstain from smoking, conversation, and any other form of activity likely to distract or disturb others. Members shall enter and leave the library with as little noise as possible.

8. The non-return of any book by a student after the expiry of the due date shall be reported by the Librarian to the Head/Coordinator of the Department, who shall take such steps as may be necessary for the recovery of the book. The cost of the book may be added to the semester fee if necessary.

9. No one will be allowed to borrow books until he/she has returned all previously issued books.

10. If the borrowed books are not renewed, a fine of Tk. 5 per day will be charged for each book. However, if one month has passed, a late fee of Tk. 500 will have to be paid.

35. Student Code of Conduct

VU is committed to maintaining proper Academic environment. Students should strictly follow the university Rules of Discipline, maintain honesty and punctuality, and have respect for the rights of others within and outside the premises of the university. Politics is completely prohibited in the campus.

Offences include the following:

- a.** Verbal, mental, physical or sexual harassment
- b.** Physical assault in any form
- c.** Direct/ indirect threats of violence
- d.** Participation in any activities subversive of discipline of the university or of the State
- e.** Willful damage or destruction of any property of the university
- f.** Smoking inside university building campus
- g.** Possession or use of alcoholic drinks and drugs or any other illegal items
- h.** Disobedience, interference, resistance or failure to comply with the instruction/order of the authorized personnel of the university on duty
- i.** Unauthorized use of university property
- j.** Theft or misappropriation of university properties and materials,
- k.** Possession of stolen university property
- l.** Adopting unfair means in the examinations
- m.** Misconduct in the examination hall

36. Examination Code of Conduct

The following measures will be taken for indiscipline and adopting unfair means in examination:

a. Cancellation of the Course: In the event that any material for adopting unfair means in the examination (example: copying papers, electronic devices for storing copies, writing on scale, writing on the desk etc.) is found in the examinee's possession, the course of the concerned semester will be cancelled.

b. Decision will be taken as per the recommendation of Disciplinary Committee:

- If the examinee creates chaos in the exam room.
- If the examinee uses abusive language/sentences and/or intimidates the invigilator and/or shows aggressive behavior to the invigilator.
- If the examinee exchanges answer script with other examinee.
- If the examinee take the answer script out of the exam room or tear off the answer script.

c. Cancellation of the Semester: In the event that any forged document (such as Admit Card, Pay Slip etc.) is found in the examinee's possession, s/he will be expelled for one (1) semester.