Master of Pharmacy
Clinical Pharmacy and Pharmacology

Total Credit for M. Pharm.: 40

Description of the Program

The **M. Pharm. in Clinical Pharmacy and Pharmacology** program is designed to equip students with an in-depth understanding of therapeutic management, clinical decision-making, and rational drug use within hospital and healthcare settings. The curriculum integrates foundational knowledge with advanced concepts in pharmacotherapy, enabling graduates to contribute effectively to patient-centered care.

This 40-credit program combines lectures, seminars, interactive small-group teaching, tutorials, research activities, and hands-on clinical training. It emphasizes both theoretical learning and practical skill development to ensure that students gain comprehensive competence in clinical pharmacy practice.

Students may choose either the **general (non-thesis) group** or the **thesis group**, each designed to meet different academic and professional goals.

Non-Thesis Group

Students enrolled in the non-thesis track must complete a supervised project. Each student is assigned an academic supervisor who also serves as a personal tutor throughout the program. Students who are already in service are encouraged to align their project with their professional responsibilities, and the Department is willing to sign confidentiality agreements if required. The project should include a minimum of eight weeks of laboratory work, excluding the time needed for writing and preparing the dissertation-equivalent report. Under special circumstances, a critical scientific review may be accepted as an alternative to laboratory work.

Thesis Group

Students in the thesis group are required to undertake **extensive, original research** in a relevant area of Clinical Pharmacy or Pharmacology. Under the guidance of an appointed supervisor, thesis students will engage in systematic investigation that may involve laboratory experiments, clinical or hospital-based studies, pharmacoepidemiological research, or applied pharmacotherapy evaluations.

The research must demonstrate scientific rigor, contribute new insights or data, and reflect the student's ability to design, execute, analyze, and interpret research findings. Upon completion, students must prepare and submit a **full dissertation**, written in accordance with the Department's academic and formatting guidelines. The dissertation should present background literature, clear objectives, detailed methodology, results, discussion, and conclusions supported by evidence. Students will also be required to defend their work before an examination committee.

At the end of the program, students from both tracks will complete **four weeks of clinical pharmacy training** in selected hospitals, providing exposure to real-world healthcare environments and patient-care activities.

Structure of the Curriculum

a. Duration of the Program: 1 year comprising of 2 semesters for the general group and 1.5 years comprising of 3 semesters for the thesis group (1 semester means 6 months).

b. Admission Requirements: Students seeking admission to pursue the course for the degree of M. Pharm. in Clinical Pharmacy and Pharmacology should have passed the B. Pharm. (Hons.) from any recognized university/institute at home and abroad. A proposed candidate for this program must have a cGPA of at least 2.50 for M. Pharm. (General Group) and 3.00 for M. Pharm. (Thesis Group) in the B. Pharm. examination.

c. Total Minimum Credit Requirement to Complete the Program: The students are required to complete all the assigned credits (40) to attain the degree.

Structure of the Curriculum

a. Duration of the Program:

- **General Group:** 1 year (2 semesters)
- **Thesis Group:** 1.5 years (3 semesters)
  (Each semester is equivalent to six months.)

b. Admission Requirements:
Applicants must hold a **B. Pharm. (Hons.)** degree from any other recognized university/institution, nationally or internationally.

- Minimum **cGPA 2.50** for admission to the **M. Pharm. (General Group)**
- Minimum **cGPA 3.00** for admission to the **M. Pharm. (Thesis Group)**

c. Minimum Credit Requirement:
Students must successfully complete **40 credits** to qualify for the degree.

Semester-Wise Distribution of Courses

M. Pharm. in Clinical Pharmacy and Pharmacology (General Group) (a university may use course code as per choice)

1st Semester		
Course Code	**Course Title**	**Credit**
PHR 0916 5101	Advanced Pharmacology	3.0
PHR 0916 5101 L	Advanced Pharmacology Lab	1.0
PHR 0916 5102	Advanced Biotechnology and Biologics	3.0
PHR 0916 5103	Advanced Pharmaceutical Analysis	3.0
PHR 0916 5103 L	Advanced Pharmaceutical Analysis Lab	1.0
PHR 0916 5104	Advanced Pharmaceutical Technology	3.0
PHR 0916 5104 L	Advanced Pharmaceutical Technology Lab	1.0
PHR 0916 5105	Research Methodology and Biostatistics	3.0
PHR 0916 5106	Project Proposal Submission and Presentation	2.0
		Total = 20

2nd Semester		
Course Code	**Course Title**	**Credit**
PHR 0916 5201	Cellular and Molecular Pharmacology	3.0
PHR 0916 5202	Toxicology and Drug Safety Management	3.0
PHR 0916 5203	Pharmacotherapy and Pharmacoepidemiology	3.0
PHR 0916 5204	Clinical Pharmacy and Pharmacy Practice	3.0
PHR 0916 5204 L	Clinical Pharmacy and Pharmacy Practice Lab	1.0
PHR 0916 5205	Project Report Submission and Presentation	3.0
PHR 0916 5206	Viva Voce	2.0
PHR 0916 5207	Hospital Training	2.0
		Total = 20
Grand Total		**40.0**

M. Pharm. in Clinical Pharmacy and Pharmacology (Thesis Group) (a university may use course code as per choice)

1st Semester		
Course Code	**Course Title**	**Credit**
PHR 0916 5101	Advanced Pharmacology	3.0
PHR 0916 5102	Advanced Biotechnology and Biologics	3.0
PHR 0916 5103	Advanced Pharmaceutical Analysis	3.0
PHR 0916 5104	Advanced Pharmaceutical Technology	3.0
PHR 0916 5105	Research Methodology and Biostatistics	3.0
PHR 0916 5107	Thesis Proposal Submission and Presentation	2.0
		Total = 17

2nd Semester		
Course Code	**Course Title**	**Credit**
PHR 0916 5201	Cellular and Molecular Pharmacology	3.0
PHR 0916 5202	Toxicology and Drug Safety Management	3.0
PHR 0916 5203	Pharmacotherapy and Pharmacoepidemiology	3.0
PHR 0916 5204	Clinical Pharmacy and Pharmacy Practice	3.0
PHR 0916 5206	Viva Voce	2.0
PHR 0916 5207	Hospital Training	2.0
		Total = 16

3rd Semester		
Course Code	**Course Title**	**Credit**
PHR0916 5301	Thesis Submission	5.0
PHR0916 5302	Thesis Presentation	2.0
		Total = 7.0
Grand Total		**40.0**

First Semester

PHR0916 5101: Advanced Pharmacology **Credits: 3.0**

Rationale of the course: Advanced Pharmacology is a dynamic science. Students will learn how to predict the behavior of a variety of medications based on facts about drug classification and the principles of pharmacology. This subject deals with the scientific knowledge and updated information about foundational parts of the pharmacological sciences to opt for major drugs into correct therapeutic categories as a basis for rational disease therapy. It also deals with the study of pharmacokinetics and pharmacodynamics of various drugs.

Chapter	Course Contents
1.	**Pharmacology of ion channels and enzymes:** Transduction mechanisms as targets of drug action, voltage sensitive ion channels-structure, and functions. Nicotinic acetylcholine receptor of skeletal muscle (structure and its function), dysfunction of the skeletal neuromuscular junction & its treatment. Pharmacology of KATP, Ca^{+2} sensitive K^+ channel, voltage sensitive K^+ channel, voltage sensitive Ca^{+2} channels, Na^+/K^+ ATPase and gap junctions.
2.	**Neuropharmacology:** Molecular and cellular mechanisms: Cell biology of ligand-gated channels and G protein-coupled receptors, roles of the glutamatergic system in stroke and neurodegeneration, roles of GABA and its receptors in disease, anxiety and epilepsy, catecholamine receptors (α- and ß-adrenoceptors, dopamine receptors), acetylcholine receptors (nicotinic and muscarinic receptors), 5HT receptors (roles in disease, migraine), opiate receptors (roles in disease, pain and addiction). Neurodegenerative diseases: Alzheimer's disease, Parkinson's disease, and schizophrenia.
3.	**Immunopharmacology:** Pharmacological aspects of clinical conditions involving immunological mechanisms: Hypersensitivity, autoimmunity, immunodeficiency. Autoimmune disorders and malignant disorders. Monoclonal antibody therapy for malignancies, immune-therapeutics including vaccines, plasma-derived immunoglobulins, immunostimulants, probiotics and prebiotics. Current concepts in theory and research of drugs for AIDS.
4.	**Cancer biology and therapy:** Introduction to the biology of cancer, clinical features and pathology of cancer, phenotypic characteristics of cancer cells. Hallmarks of cancer. Molecular causes of cancer, mutation and carcinogenesis: Oncogenes, tumor suppressor genes, DNA repair gene. Major approaches for cancer treatment. Targeted Cancer Therapy, modes of treatments: Radiotherapy, chemotherapy, biological therapy including

	immunology and gene therapy. Molecular mechanism for resistance against anticancer drugs.
5.	**Ocular pharmacology:** Definition, types, causes, signs and symptoms, prevention, treatment of various ocular diseases: Cataract, glaucoma, color blindness, chalazion, blepharitis, Bell's palsy, astigmatism, amblyopia, Eales' disease, age-related macular degeneration, diabetic retinopathy and ocular angiogenesis
6.	**Autacoids:** Eicosanoids (prostaglandins, leukotrienes, thromboxane, and related compounds) nitric oxide oxygen free radicals, role of endothelium in vascular function, cytokines, opioid autacoids.
7.	Any additional topics deemed appropriate by the course teacher.

PHR0916 5101L: Advanced Pharmacology Lab **Credit: 1.0**

Rationale of the course: This is a core lab course that provides students with hands-on training on the basic laboratory techniques for the estimation of different metabolites, plasma drug concentration from blood and understanding of drug effects on animal models.

Course Contents

1. Estimation of cholesterol level by enzymatic method.
2. Estimation of blood glucose level by enzymatic method
3. Determination of blood uric acid level by enzymatic method.
4. Estimation of membrane stabilizing activity by hypotonic solution induced hemolysis.
5. Estimation of membrane stabilizing activity by heat induced hemolysis.
6. Estimation of plasma protein by Biuret method.
7. Estimation of plasma protein by Biuret method.
8. Estimation of paracetamol level in human blood after oral administration by UV-visible spectrophotometric method.

Recommended Books:

1. Goodman & Gillman's Pharmacological Basis of Therapeutics- J. G. Hardman
2. Basic and Clinical Pharmacology- B. G. Katzung
3. Medical Pharmacology- A. Goth
4. Pharmacology & Pharmacotherapeutics- R. S. Satosker

5. Clinical Pharmacology- D. R. Laurence, P. N. Bennett and M. J. Brown
6. Clinical Pharmacy and Therapeutics- R. Walker and C. Edwards

PHR0916 5102: Advanced Biotechnology and Biologics **Credits: 3.0**

Rationale of the course: Biotechnology uses microorganisms and products to perform specific industrial processes and improve the quality of life. Advanced Biotechnology is a theoretical course which builds on knowledge already acquired by students in Enzyme Biotechnology. It covers methods and applications of biotechnology, examines present and future developments in this area. This course provides an overview of microbial metabolism, biosynthesis of primary and secondary metabolites and examines in detail the different stages of the biotechnological process. Students learn about fermentation products of microorganisms and their importance in food, health, agriculture and environment.

Chapter	Course Contents
1.	**Molecular biotechnology:** Introduction to biotechnology, protein structure and engineering, introduction, the cell, gene expression, recombinant DNA technology, specific DNA techniques, areas of interest in biotechnology, therapeutic and pharmaceutical applications of biotechnology, cell and tissue culture.
2.	**Genetic engineering tools:** Restriction modifications enzymes used in recombinant DNA technology, cloning vectors: Plasmid cloning vector PBR322 and other plasmid vectors, cloning of foreign genes: Vectors for large piece of DNA – bacteriophage I vectors and other phage vectors, cosmids, YAC and BAC vectors, genetic transformation of prokaryotes.
3.	**Monoclonal antibodies and enzyme immobilization:** Introduction to enzyme, structure of antigen and antibody, monoclonal antibodies and hybridoma technology, production of monoclonal antibodies: Principle involved in hybridoma technology, applications of monoclonal antibodies, specificity of enzymes, immobilization of enzyme, tissue engineering.
4.	**Implementation of biotechnology in drug development**: Application of biotechnologies in drug discoveries and development, production of recombinant proteins, impact of genomics, proteomics, and related technologies upon drug discovery.
5.	**Therapeutics based on biotechnology:** Hormones, enzymes, antibodies and derivatives, vaccines, blood products, and nucleic acid therapies, gene and cell therapy: Overview of gene and cell therapeutics, human diseases targeted

	for gene therapy, vectors for gene therapy, and future of gene therapy.
6.	**Formulation and dispensing of biotech products:** Formulation of protein, peptide, antibody etc, microbiological consideration, excipients used in parenteral formulations of biotech products, delivery of proteins: Routes of administration and absorption enhancement, delivery of proteins: Approaches for rate controlled and target site specific delivery, storage, handling, preparation, administration, outpatient or home care issues, reimbursement, educational materials, professional education, and product information.
7.	**Bioinformatics and proteomics:** Introduction to bioinformatics: The fundamentals of protein and nucleic acid sequence analysis. Genomics: What is genomics? Whole genomes sequencing, genome sequence acquisition and analysis, evolution and genomes, biomedical genome research: Genomic sequences to make new vaccines, new types of antibiotics and medications, proteomics: Introduction, protein 3D structures, signal processing for proteomics, protein interaction networks.
8.	Any additional topics deemed appropriate by the course teacher.

Recommended Books:

1. Pharmaceutical Biotechnology- D. Commelin
2. Pharmaceutical Biotechnology- Vyas
3. Introduction to Biotechnology and Genetic Engineering- A. J. Nair
4. Pharmaceutical Biotechnology Fundamentals and Applications- C. R. Kokare
5. Biotechnology for beginners- R. Renneberg

PHR0916 5103: Advanced Pharmaceutical Analysis **Credits: 3.0**

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

Chapter	Course Contents
1.	**NMR spectroscopy:** Local diamagnetic shielding and magnetic anisotropy, spin-spin splitting, different spin system including AB, AX, ABC, ABX, AMX, AMNX etc., Pascal Triangle, coupling constant, mechanism of coupling, quadrupole broadening and decoupling, simplification of proton NMR spectra, water peak suppression, resolution of NMR spectra. Effect of stereochemistry on the spectrum, shift reagents. ^{13}C NMR, DEPT, APT, COSY, TOCSY, NOESY, ROSEY, 2D-HETCOR, INADEQUATE, HSQC, HSQC-TOCSY, HMBC, etc. LC-NMR, hyphenated NMR spectroscopy. Applications of ^{1}H- and ^{13}C-NMR and with some examples. Practice problems on structure elucidation using NMR, MS, FTIR, ATIR, etc.
2.	**Mass spectrometry:** Essential components of mass spectrometer, ionization techniques, mass analyzers, types of ions, metastable ion, isotopic ions and their corresponding peaks, rules of fragmentation, McLafferty rearrangement, mass spectral fragmentation of organic compounds containing common functional groups, retro Diels Alder and other fragmentation patterns. Introduction to FAB, TPSI, TOF, MALDI-TOF, LC-MS, CI-MS, GC-MS, LCMS/MS.
3.	**UV spectrophotometry:** Introduction, theory, instrumentation, and advanced applications.
4.	**IR spectrophotometry:** Introduction, theory, instrumentation, and advanced applications.
5.	**HPLC:** Introduction, theory, instrumentation, and advanced applications.
6.	**Thermal analysis:** Principles and applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC).
7.	**Electrochemical methods of analysis:** Conductometry, amperometry, polarography, potentiometry, controlled potential electrolysis.
8.	Any additional topics deemed appropriate by the course teacher.

PHR0916 5103L: Advanced Pharmaceutical Analysis Lab **Credit: 1.0**

Rationale of the course: 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, polarimetric and titrimetric methods. This course also focuses on microbiological assay methods for measuring compounds such as vitamins and amino acids, using microorganisms.

Course Contents

1. Pharmaceutical analysis of drugs using spectrophotometer, polarimeter, thin-layer chromatography, non-aqueous titration etc.
2. Microbiological assay of vitamins and antibiotics.
3. Determination of saponification and iodine values of fixed oils.
4. Assay of milk of magnesia suspension.
5. Assay of milk of magnesia emulsion.

Recommended Books:

1. A Textbook of Pharmaceutical Analysis- K. A. Connors
2. Pharmaceutical Chemistry- L. G. Chatten
3. A Textbook of Quantitative Inorganic Analysis Vol. I & II- Vogel
4. United State Pharmacopoeia and British Pharmacopoeia
5. Quality Control in Pharmaceutical Industry- M. S. Cooper
6. Practical Pharmaceutical Chemistry, Vol. I and II- A. H. Backett & J. B. Stenlake
7. Introduction to Organic Laboratory Techniques: A Contemporary approach- D. L. Pavia, G. M. Lampman, G. S. Krij
8. Quantitative Pharmaceutical Analysis (Vol I & II)- Chatten
9. Elementary Organic Spectroscopy – S. Chand and Y. R. Sharma

PHR0916 5104: Advanced Pharmaceutical Technology **Credits: 3.0**

Rationale of the course: Advanced Pharmaceutical Technology is designed to introduce the principles, preparation, and control of liquid dosage forms, dispersed systems, 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, physical-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.

Chapter	Course Contents
1.	**Quality assurance, quality management, design of quality systems:** cGMP in pharma industry, protocols in pharma industry (production protocols, standard operating procedures, SOP), quality control, chemical and radiochemical identity and purity, audit, monitoring, internal and external inspections, alternative quality systems (nationally and internationally).
2.	**Overview of ICH guidelines and optimization techniques**: QSEM, with special emphasis on Q-series guidelines (Q1- Q12), application of optimization techniques in pharmaceutical formulation, optimization parameters, statistical design and DOE software.
3.	**Pharmaceutical production facilities - design and applications:** Master plan, project planning and management, site selection planning, pilot plant scale up technique, pharmaceutical plant layout.
4.	**Calibration and validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, qualification of UV-Visible spectrophotometer, general principles of analytical method validation
5.	**Technology transfer:** Development of technology by R & D, technology transfer from R & D to production, optimization and production, qualitative and quantitative technology models. Documentation in technology transfer: Development report, technology transfer plan and exhibit.
6.	**Advanced tablet technology:** Tablet granulation and compression techniques, granulation of powders for tablet processing, compression physics in the formulation development of tablets, different stages of tablet compression and problems associated with large scale manufacturing of tablets.
7.	**Advanced drug delivery systems:** Controlled release oral drug delivery systems, parenteral controlled release drug delivery systems, implantable therapeutic systems, transdermal delivery systems, ocular and intrauterine delivery systems, vaccine delivery, biochemical and molecular biology approaches to controlled drug delivery of: Bio adhesive drug delivery systems, nasal drug delivery systems, drug delivery to colon, drug targeting to particular organs: Delivery to lungs, delivery to the brain and problems involved, drug targeting in neoplasms
8.	**Biotechnology preparations/ formulation of biotech products:** Definitions, historical use and applications, composition, preparation, physicochemical considerations, short study of current biotech products e.g. hematopoietic

	growth factors, interleukins and interferons, insulin, growth hormones, vaccines, monoclonal antibody-based pharmaceuticals, recombinant tissue type plasminogen, recombinant human deoxyribonuclease, follicle stimulating hormone (FSH), quality control, storage and stability of biotech products.
9.	**Pharmaceutical packaging:** Pharmaceutical dosage form and their packaging requirements, pharmaceutical packaging materials, medical device packaging, enteral packaging, aseptic packaging systems, container closure systems, issues facing modern drug packaging, selection and evaluation of pharmaceutical packaging materials.
10.	**Kinetics and drug stability:** Stability calculations, rate equation, kinetics of drug decompositions, strategy of stability testing, methods of stabilization, methods of accelerated stability testing in dosage forms. Freeze-thaw methods, centrifugal methods, temperature and humidity control.
11.	Any additional topics deemed appropriate by the course teacher.

PHR0916 5104L: Advanced Pharmaceutical Technology Lab Credit: 1.0

Rationale of the course: This is a core lab course in the Master of Pharmacy program that provides understanding of preparation and evaluation of different dosage forms such as tablets, capsules, and injections. It will also enable students to solve case studies regarding manufacturing and validation which will be analyzed by the student and they will provide the solutions of those problems.

Course Contents

1. Preparation of orally disintegrating tablet using rotary tablet press and its physical evaluation.
2. Preparation of effervescent tablet using rotary tablet press and its physical evaluation.
3. Preparation of IR tablet using wet granulation, dry granulation and direct compression method using rotary tablet press and its physical evaluation.
4. Preparation of sustained release tablet using rotary tablet press and its physical evaluation.
5. Preparation of sterile ophthalmic solution and its physical evaluation.
6. Preparation of ophthalmic ointment in tube and its physical evaluation.
7. Preparation of SVP in ampoule and vial and their physical evaluation.
8. Preparation of IR pallet dosage form and its physical evaluation.
9. Preparation of SR pallet dosage form and its physical evaluation.
10. Preparation of rapidly dissolving oral thin film and its physical evaluation.

11. Test of primary and secondary packaging materials including ampoule, vial, rubber stopper cartons, aluminum foils and films used for blister packing.
12. Stability testing of immediate release and sustained release solid dosage forms.

Recommended Books:

1. Remington's Pharmaceutical Sciences
2. Dispensing of Pharmaceutical Students – Cooper and Gunn
3. Pharmaceutical Dosage Forms-Tablet-H.A. Lieberman, L, Lach. and JB. Schwartz.
4. Bentley's Textbook of Pharmaceutics
5. An Introduction to Pharmaceutical Formulations – Fishburn
6. Pharmaceutical Dosage Forms – Ansel
7. Pharmaceutics and Pharmacy Practice – Banker and Chalmers
8. The Art, Science and Technology of Pharmaceutical Compounding – L. V. Allen Jr.
9. Theory and practice of Industrial Pharmacy – Lachmann
10. American Pharmacy- Sprowl
11. Pharmaceutics – Aulton
12. Targeted and Controlled Drug Delivery- Novel.
13. Encyclopedia of Pharmaceutical Technology-J. Swarbrick and J.C. Boylan.
14. Dispensing of Medication- Husa & Martin
15. An Introduction to Pharmaceutical Productions- J. Polderman

PHR0916 5105: Research Methodology and Biostatistics **Credits: 3.0**

Rationale of the course: This course is designed to equip M. Pharm students with the essential knowledge and skills required to design, conduct, and evaluate scientific research. It provides a strong foundation in research principles, data collection methods, and ethical standards. Through biostatistical tools and analytical techniques, students learn to interpret data accurately and make evidence-based decisions, thereby strengthening their capacity for high-quality thesis work and advanced pharmaceutical research.

Chapter	Course Contents
1.	**Fundamentals of research:** Overview of the concept, purpose, and objectives of research; formulation of hypotheses; significance and motivations for conducting research; classification of research types including experimental studies, clinical trials, surveys, and qualitative and quantitative approaches; introduction to primary and secondary data sources; key steps in

	the research process; and basic concepts of epidemiology and levels of research.
2.	**Problem identification and importance of the research:** Research problem, selecting research problem, problem formulation, identifying variables and specify research objectives; characteristics and examples of good research topics; reasons why research questions are crucial.
3.	**Literature review:** Definition of literature review, importance of literature review before formulating research, sources of documents for literature review, types of literature review, search and sorting strategy of articles, process to carry out a literature review.
4.	**Planning and designing of research:** Key components and purpose of a research proposal; basic structure and essential preparatory steps before starting a study; development of survey questionnaires; general principles of animal care and patient handling; ethical considerations; and fundamental planning of research activities and materials.
5.	**Research report writing: thesis or dissertations, and scientific articles:** Core components of scientific documents, including title, authorship, abstract, introduction, objectives, methods, results, discussion, conclusion, and references. Essentials of data presentation using tables and graphs, basic descriptive analysis, interpretation of findings, and reporting study limitations.
6.	**Sampling design:** Types of sampling design, statistical considerations and steps in sampling design, characteristics of a good sample design, selecting a random sample, examples of good sampling.
7.	**Estimation and hypothesis testing:** Statistical estimation and confidence intervals; principles of hypothesis testing; comparison of variances in independent samples; tests for equality of multiple variances; confidence limits for a variance; and the use of tolerance intervals.
8.	**Statistical analysis of data:** Data Analysis by different types of statistical methods including ANOVA (analysis of variance), Tukey HSD, Dunnett's-test, Student *t*-test, Chi-square test, one-way and two-way ANOVA; analysis of qualitative studies.
9.	**Experimental design in clinical trials:** Introduction to clinical trial designs; key principles of experimental design and analysis; parallel designs; crossover designs and bioavailability/bioequivalence studies; repeated-measures (split-plot) designs; multicenter studies; and interim analyses.
10.	**Optimization techniques and screening designs:** Introduction to optimization; factorial designs; composite designs for estimating curvature; simplex lattice methods; sequential optimization; and screening designs.
11.	Any additional topics deemed appropriate by the course teacher.

Recommended Books:

1. Research Methodology: Methods and Techniques by C. R. Kothari.

2. Rajender R Aparasu. 2011. Research Methods for Pharmaceutical Practice and Policy.
3. Pharmacy Research and Evaluation Resource. In: Research Methods in Pharmacy Practice Research. 2010.
4. Donald A Berry (Ed.). 1990. Statistical Methods in the Pharmaceutical Sciences.
5. Friedman, Furberg, DeMets (1996), Fundamentals of Clinical Trials
6. F L Ramsey and D W Schafer (2002). The statistical sleuth- a course in methods of data analysis.
7. M Pagano and K Gauvreau (2000). Principles of biostatistics.
8. S Bolton (1997) Pharmaceutical Statistics.
9. Statistical Methods for Research Workers by Fisher R. A.

PHR0916 5106: Project Proposal Submission and Presentation Credits: 2.0

Rationale of the course: This is a research-oriented course in Master of Pharmacy program that imparts practical knowledge on active research. In this course, students will be able to conduct individual research work based on their chosen topic in project proposal. They will do active lab work, collect data, analyze data, interpret the obtained results, and compile the research report/project report under the supervision of his /her supervisor. Finally, they will submit their research project book and present a power point presentation on their completed research work.

Recommended References

1. Google Scholar
2. PubMed
3. Scopus, Web of Science and Science Direct
4. All the relevant text books

PHR0916 5107: Thesis Proposal Submission and Presentation Credits:2.0

Rationale of the course: This is a research-oriented course in Master of Pharmacy program that imparts practical knowledge on active research. In this course, students will be able to write a synopsis or research proposal which will be done in thesis work (in 3rd semester) under the supervision of an assigned faculty member of the department. Besides, at the end of the semester, the students will have to give a presentation on the chosen research topic.

Recommended References

1. Google Scholar
2. PubMed
3. Scopus, Web of Science and ScienceDirect
4. All the relevant text books

Second Semester

PHR0916 5201: Cellular and Molecular Pharmacology **Credits: 3.0**

Rationale of the course: Cellular and Molecular Pharmacology is a science that seeks to improve human health with drugs. This course entails basic biochemistry, pharmacological and molecular mechanism of various drugs, structural and functional activities of drug targets; focuses on how the effect of drugs alters with genetic mutation and polymorphism, several genetic disorders as well as recommended therapy and is closely related to genomics and bioinformatics. These aforementioned topics will effectuate the student's better understanding on chemical and biological principles of living systems, molecular basis of drug action and facilitate their knowledge to explore the advancement of pharmaceutical therapy based on genetics.

Chapter	Course Contents
1.	**Basic biochemistry:** Discovery of cell and cell theory, comparison between plant and animal cells, cell wall, plasma membrane, modification of plasma membrane and intracellular junctions, cytoskeleton, protoplasm, mitochondria, chloroplast, endoplasmic reticulum, Golgi complex, lysosome, endosome and microbodies, ribosome; centriole, nucleus, chemical components of a cell, catalysis and use of energy by cells, DNA, RNA.
2.	**Cell and receptor pharmacology:** The study of the cell, including all its physiological properties, functioning, structure, components and life cycle, cell signaling, cell cycle and signal transduction, cell proliferation, receptors, function of specific receptor (cholinergic receptor, adrenergic receptor, glutamate receptor, GABA receptor, G-protein coupled receptor etc.).
3.	**Genetic engineering and regulation:** Expression of genetic information: From transcription to translation, the relationship between genes and protein, transcription and RNA processing in eukaryotic cells, encoding genetic information, decoding the codons: The role of transfer RNAs, Hox genes regulation and developmental functions, regulation of mRNA stability.
4.	**Genetics of complex human disease/genetic disorder:** Genetics and obesity, genetics and autism, genetics and schizophrenia, genetics and Parkinson's disease, genetic diagnosis of the fetus, reproductive and cancer genetics, Gaucher disease, Wilms tumor, cystic fibrosis, and other common disease.
5.	**Gene therapy:** Stem cell technology and regenerative medicines, immunology, fermentation technology, germ immunization, tissue culture technology.
6.	**Pharmacogenomics and pharmacogenetics:** Definition of pharmacogenetics and pharmacogenomics, race and ethnicity, SNP and other polymorphism,

	Use of SNP in pharmacogenomic studies, role of different SNP on various disorders (lung, breast, colon, cervical cancer etc.) and drug activity (clopidogrel, aspirin etc.), RFLP and direct sequencing and other methods for studying and identifying the polymorphisms.
7.	**Bioinformatics and transmission genetics:** Definition, mendelism and chromosome theory, extension of mendelism, linkage and crossing over, allelic variation and gene function. Non mendelian inheritance, chromosome mapping, special topic: X-chromosome inactivation in mammals, pedigree analysis, various software and databases for sequence and structure analysis.
8.	Any additional topics deemed appropriate by the course teacher.

Recommended Books:

1. Molecular Pharmacology: From DNA to Drug Discovery, 2013, Authors: John Dickenson, Fiona Freeman, Chris Lloyd Mills, Shiva Sivasubramaniam, Christian Thode, John Wiley & Sons, Ltd.
2. General and Molecular Pharmacology: Principles of Drug Action, 2015. Edited by- Francesco Clementi, Guido Fumagalli, John Wiley & Sons, Ltd.
3. The Molecular Basis of Cancer, 2015. Edited by - John Mendelsohn, Joe W. Gray, Peter M. Howley, Mark A. Israel and Craig B. Thompson. Elsevier-Saunders.
4. Oncology at a Glance, 2013. Graham G. Dark. Wiley-Blackwell.

PHR0916 5202: Toxicology and Drug Safety Management Credits:3.0

Rationale of the course: The prime objective and intended learning outcomes of this course will be to help students understand the various aspects, scopes and application of advanced toxicology. In this course, students will learn to apply their knowledge of basic toxicokinetic principles and metabolic systems to elucidate mechanisms of toxicity induced by xenobiotic compounds.

Chapter	Course Contents
1.	**Basic concepts of toxicology:** Introduction to toxicology, sub disciplines of toxicology, qualitative and quantitative aspects of toxic effects. Classification of toxic agents, interaction of chemicals, tolerance, dose response, variation in toxic responses, descriptive animal toxicity tests. Toxicological evidence, common household poisons. Types of adverse drug reaction, risk assessment and toxicity testing, nonmetallic environmental toxicants, chelators and heavy metal intoxication.

2.	**The mechanism of toxin action:** General mechanisms of toxin-induced cell damage and death- hepatotoxicity and nephrotoxicity, mutagenesis and carcinogenicity, biochemical mechanisms of mutagenesis, carcinogenesis, genotoxic and epigenetic carcinogens, teratogenesis and drug-induced fetal damage, and allergic reactions to drugs.
3.	**Toxicokinetics:** Definition, toxic exposure, absorption, distribution, elimination, toxication and detoxification, molecular mechanism of toxicity: Nonspecific macromolecular damage, reactive species, inflammatory and immune-mediated mechanism, enzyme-mediated toxicity, receptor-mediated toxicity, teratogenesis.
4.	**Target organ toxicity**: Dermato-toxicology, respiratory toxicology, gastrointestinal toxicology, hepato-toxicology, nephro-toxicology, cardiovascular toxicology, toxicology of blood.
5.	**The biotransformation of toxins, their inactivation and removal from the body:** An introduction to biotransformation. The cytochrome P-450 system–its function, mechanism of action and regulation. Glutathione and glutathione-S-transferase–its function, mechanism of action and regulation.
6.	**Therapeutic drug monitoring:** Role of drug monitoring therapeutics, classification TDM, drugs for which TDM is used, why TDM is necessary, pharmacokinetic & practical considerations.
7.	**Clinical toxicology:** Definition, role & status of poison centre, poison prevention, analysis of a poisoning situation, information sources of poisoning, management of poisoning situation- decreasing absorption, hastening excretion, systemic antidotes (naloxone, deferoxamine, digibind, N-acetylcysteine).
8.	**Clinical sign, symptoms & management of poisoning:** Epidemiology, organophosphate poisoning, TCA poisoning, benzodiazepine poisoning, carbon monoxide poisoning.
9.	Any additional topics deemed appropriate by the course teacher.

Recommended Books:

1. Casarett and Doull's Toxicology: The Basic Science of Poisons. Curtis D. Klaassen, Ph.D.
2. A textbook of modern toxicology. Ernest Hodgson Ph.D.
3. Introduction to Toxicology, by John Timbrell.
4. Toxicological Chemistry and Biochemistry, Third Edition, by Stanley E. Manahan.

PHR0916 5203: Pharmacotherapy and Pharmacoepidemiology Credits:3.0

Rationale of the course: This subject focuses on critical care and cancer pharmacotherapy, pathophysiology and therapeutic management of various disorders, and pharmacoepidemiology regarding drug safety and effectiveness. This course was designed to update student's knowledge and implementation of their knowledge in pharmacy practice.

Chapter	Course Contents
1.	**Introduction to critical care pharmacotherapy:** Critical care conditions, pharmacotherapy for burn, cardiovascular, medical, neurology, surgical, trauma patients and tele-ICU, fundamental activities of a critical care pharmacist, management of ICU patients, medication error and ADEs in ICU.
2.	**Pharmacotherapy:** Pharmacotherapy in different life stages (neonates, geriatric, pediatric), pharmacotherapy for tuberculosis, malaria and several infectious disorders.
3.	**Cancer pharmacotherapy:** Cancer and available treatments, factors that determine how anticancer drugs are classified, types of chemotherapy, how chemotherapy affects cell's DNA and RNA, therapeutic regimen of various anti-cancer drugs, adverse effects of chemotherapy, surgery, radiation therapy, bone marrow transplant, immunotherapy, hormone therapy etc.
4.	**Pathophysiology and therapeutic management of various diseases:** Peptic ulcer disease, inflammatory bowel disorder, liver disease, kidney disease, hypertension and coronary artery disease, thrombosis, anxiety disorders.
5.	**Introduction of pharmacovigilance:** Overview of pharmacovigilance, standard terms and terminology in pharmacovigilance, terminologies of adverse medication related events, history and development of pharmacovigilance, importance of safety monitoring of medicine, WHO international drug monitoring program, national medicinal drug policy: Their relationship to pharmacoepidemiology
6.	**Medical evaluation of adverse events in pharmacovigilance:** Adverse event reporting system, diagnosis and managements of ADRs, medical evaluation of AE, pharmacovigilance method: Passive surveillance, active surveillance, comparative observational studies (cross sectional study, case control study and cohort study), targeted clinical investigations.
7.	**Drug safety and effectiveness:** Vaccine pharmacovigilance, vaccination failure, adverse events following immunization, effective communication in pharmacovigilance, communication in drug safety crisis management, drug utilization, indicator based approach in drug use studies- a. Prescribing indicators b. Patient care indicators
8.	Any additional topics deemed appropriate by the course teacher.

Recommended Books:

1. Clinical Pharmacy and Therapeutics by Roger Walker and Cate Whittlesia (Latest edition)
2. Pharmacoepidemiology, Storm B. L. (Ed), John Wiley and Sons Ltd, England, (Latest edition)
3. Textbook of Pharmacoepidemiology, Storm B. L. And Kimmel S.E. (Eds), John Wiley, New Jersey. (Latest edition)

PHR0916 5204: Clinical Pharmacy and Pharmacy Practice **Credits: 3.0**

Rationale of the course: The clinical Pharmacy and Pharmacy Practice course addresses the needs of the students by presenting contemporary drug therapy that can be used to prepare and update the pharmacy students with unique skills and knowledge of advanced drug therapy. The content of this course aims to develop advanced knowledge, skills, and attributes in the professional practice of Pharmacy and ensure the safe, effective, and rational use of medicines. The program will provide a wide range of opportunities to enable individuals to develop an in-depth understanding of the evidence base and safety framework for healthcare and medicines management.

Chapter	Course Contents
1.	**Introduction to clinical pharmacy:** Definition, evolution and scope of clinical pharmacy, international and national scenario of clinical pharmacy practice, activities of clinical pharmacists, level of action of clinical pharmacists, how does clinical pharmacy differ from pharmacy, pharmaceutical care- key elements of the care process, pharmaceutical consultation.
2.	**Fundamentals of diseases, symptoms, treatment & management:** GI disorders, cardiovascular, neurological, respiratory diseases, malignant: Lung, skin, ovarian, prostate, breast cancer etc., RA, osteoarthritis, gout, hyperuricemia.
3.	**Hospital acquired disease:** Epidemiology, main routes of transmission-contact, droplet, airborne, vector borne, common vehicle transmission, direct contact, indirect contact. Prevention- sterilization, isolation, handwashing, surface sanitation.
4.	**Modern dispensing aspects:** Patient medication history interview. Basic concept of medicine and poison information services. Basic concept of pharmacovigilance and AEFI. Patient medication counseling. Drug utilization

	evaluation. Documentation of clinical pharmacy services. Quality assurance of clinical pharmacy services.
5.	**Drug interactions:** Definition and introduction. Mechanism of drug interaction. Drug-drug interaction with reference to analgesics, diuretics, cardiovascular drugs, gastro-intestinal agents. Vitamins and hypoglycemic agents. Drug-food interaction.
6.	**Importance of standard treatment guideline:** Introduction, importance of standard treatment guidelines. Standard treatment in therapeutic process, advantages of standard treatment, key features of standard treatment, development of standard treatments, implementation of standard treatments, standard treatment guidelines in different countries. Standard treatment guidelines for health centers, relevance to common drugs use decisions
7.	**Hospital pharmacy:** Definition, relationship of hospital pharmacy department with other departments, organizational structure, legal requirements, workload statistics, infrastructural requirements, hospital pharmacy budget and hospital pharmacy management.
8.	**Community pharmacy practice:** Definition, roles & responsibilities of community pharmacists and their relationship with other health care providers. Community pharmacy management: Legal requirements to start community pharmacy, site selection, lay out & design, drug display, super drug store model, accounts and audits, good dispensing practices, different software's & databases used in community pharmacies. Entrepreneurship in community pharmacy. Healthcare system in Bangladesh, healthcare problems in Bangladesh.
9.	Any additional topics deemed appropriate by the course teacher.

PHR0916 5204L: Clinical Pharmacy and Pharmacy Practice Lab Credit: 1.0

Rationale of the course: This is a basic lab course that provides students with hands-on training on the basic laboratory techniques for health screening like blood pressure, blood glucose level from blood, and understanding method like filtration, sterilization method. This also provides the knowledge on prescription handling and selection on drugs.

Course Contents

1. To design a community pharmacy to incorporate all pharmaceutical care services
2. To sterilize conical flask, pipette by dry heat sterilization method.
1. To sterilize the following objects by moist heat sterilization method using autoclave: (i) Rubber gloves, (ii) Rubber closures, (iii) Surgical dressings
2. To prepare 50 ml of 5% dextrose solution and sterilize it by filtration method.

3. To perform the identification test for absorbent cotton wool.
4. To find out the percentage variation in length and width of the given sample of bandage.
5. To perform thread, count for given sample of dressing/gauge.
6. To study various components of computer.
7. To study and to operate the health screening equipment for blood pressure, measurement (sphygmomanometer.)

Recommended Books:

1. Clinical Pharmacy and Therapeutics. E. T. Herfindal, D. R. Gourley and L. L. Hart.
2. Clinical Pharmacy and Therapeutics. Roger Walker and Cate Whittlesea.
3. Davidson's Principles and Practices of Medicines. N. R. Colledge, B. R. Walker and S. H. Ralston.
4. Clinical Pharmacology and Therapeutics. J. M. Ritter, L. D. Lewis, T. G. K. Mant and A. Ferro.
5. Oxford Handbook of Clinical Pharmacy, P. Wiffen, M. Mitchell, M. Snelling and N. Stoner.
6. The Pharmacy Ordinance, 1976. Ministry of Law and Parliamentary Affairs, Government of Bangladesh, Dhaka
7. The Drugs (Control) Ordinance, 1982, Ministry of Law and Land Reforms Government of Bangladesh, Dhaka
8. Drug Policy of Bangladesh, Ministry of Health and Population Control, Health Division, Dhaka
9. A Textbook of Forensic Pharmacy – B M Mithal
10. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh
11. Remington's Pharmaceutical Science

PHR0916 5205: Project Report Submission and Presentation **Credits: 3.0**

Rationale of the course: This is a research-oriented course of Master of Pharmacy program that imparts practical knowledge on active research. In this course, students will able to conduct individually research work based on their chosen topic in project proposal. They will do active lab-work, collect data, analyze data, interpret the obtained results and compile the research report/project report under the supervision of his /her supervisor. Finally, they will submit their research project book and present a power point presentation on their completed research work.

Recommended References:

1. Google Scholar
2. PubMed
3. Scopus, Web of Science and ScienceDirect
4. All the relevant text books

PHR0916 5206: Viva Voce **Credits:2.0**

Rationale of the course: This course assesses the student's overall understanding of pharmaceutical sciences and their ability to integrate knowledge from coursework and research. It enhances critical thinking, problem-solving, and oral communication skills through direct academic questioning. The viva process encourages clarity of expression, scientific reasoning, and professional confidence. It ensures that students are adequately prepared for advanced research, clinical practice, and professional responsibilities.

PHR0916 5207: Training on Hospital Pharmacy **Credits: 2.0**

Rationale of the course: Training on hospital pharmacy is an applied course of this program. Students are expected to work with the health care providers of different renowned hospitals and gather first-hand experience relevant to prescription handling, interpretation of pathological data, selection of drugs for specific patient management, monitoring the outcomes of treatment, drug procurement & storage, in-patient & out-patient medicine distribution and other related activities.

Recommended References

1. Google Scholar
2. PubMed
3. Scopus, Web of Science and ScienceDirect
4. All the relevant text books

Third Semester

(Only for thesis group)

PHR0916 5301: Thesis Submission **Credits:5.0**

Rationale of the course: This course enables M. Pharm. students to apply research methodology and scientific principles to complete an independent research project. It ensures the development of skills in data analysis, interpretation, and academic writing. Through supervised research, students learn to produce a coherent, evidence-based thesis aligned with professional standards. The submission process fosters scholarly integrity, critical thinking, and competence in pharmaceutical research.

PHR0916 5302: Thesis Presentation **Credits:2.0**

Rationale of the Course: This course is designed to develop students' ability to effectively communicate their research findings to academic and professional audiences. It trains them in scientific presentation skills, defense strategies, and responding to evaluators' questions. By presenting their thesis work, students refine their clarity, confidence, and analytical reasoning. The course strengthens their capacity to translate research outcomes into meaningful scientific contributions.

Recommended References:

1. Google Scholar
2. PubMed
3. Scopus, Web of Science and ScienceDirect
4. All the relevant text books