

Syllabus for
Bachelor of Pharmacy
B.Pharm (Hons.)
Session: 2018-2019
Examination- 2022



(Established under Act. No 37 1980)

DEPARTMENT OF PHARMACY
FACULTY OF APPLIED SCIENCE AND TECHNOLOGY
ISLAMIC UNIVERSITY
KUSHTIA-7003, BANGLADESH

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B.Pharm (Hons.) Part-I: 2019
B.Pharm (Hons.) Part-II: 2020
B.Pharm (Hons.) Part-III: 2021
B.Pharm (Hons.) Part-IV: 2022

The B.Pharm (Hons.) courses consists of total 160 credits of eight semesters spread over four academic years. No students shall be allowed to stay for more than two academic years in each of the 1st, 2nd and 3rd year of the program. There shall be theoretical, practical, viva-voce, class assessment/tutorial/terminal/ home assignment, project/ in-plant training and related subjects. An honours student, for obtaining the degree, shall have to pass all the examinations within 6 (six) academic years from the date of his/ her first admission and shall not be allowed to stay for more than 2 (two) academic years in each of his/ her first, second, and third year honours classes. The non-credit Islamic Studies/Bangladesh Studies course shall have to be passed in two (Two) academic years from the date of his/ her admission.

The duration of examination of the theory courses shall be 3 and 4 hours for 2.00 and 3.00 credits unit courses, respectively. The duration of practical examination shall be 6-12 hours (4-6 hours per day) per 1.50 credits practical courses.

The core courses of the curriculum consist of the following subjects

1. **Pharmaceutics** includes Pharmaceutical Technology, Industrial Pharmacy, Pharmaceutical Microbiology, Hospital Pharmacy, Dispensing, Pharmaceutical Marketing and Sales, Management, Pharmacy law and Administration, Physical Pharmaceutics, Dosage Form Design, Pharmaceutical Engineering, Cosmetology and Biopharmaceutics & Pharmacokinetics.
2. **Pharmaceutical Chemistry** includes Inorganic and Organic chemistry, Physical chemistry, Synthetic and natural medicinal products, Pharmaceutical analysis and quality control.
3. **Pharmacology** includes General Pharmacology, Clinical Pharmacy, Community Pharmacy, Drug Interaction and Toxicology.
4. **Pharmacognosy** includes various aspects of natural crude drugs and other economic products of pharmaceutical importance, Traditional Medicine and Forensic Pharmacy.
5. **Physiology & Pathology** are considered as the basis of the Pharmacology course given in advance years of study.

6. **Mathematics and Biostatistics** are required for pharmaceutical calculations of formulation and statistical analysis and interpretation of biological studies and experimental results.
7. **Computer** course is included for understanding practical uses of computers in health services, research, manufacturing and quality assurance activities.

Vision:

To achieve excellence and leadership in sustainable and innovative pharmacy education, research and practice for the wellness of the society.

- (1) To impart scientific knowledge for the identification, formulations, preparation, standardization, quality control, safe uses of drugs & medicines and effective management of their distribution and sale.
- (2) To produce skilled manpower's to manage the affairs of hospital pharmacies, pharmaceutical industries, clinical pharmacy services, community pharmacy services, drug administration and other organizations in drug research, marketing, sales and administration.
- (3) To encourage research on different fields of pharmacy so as to develop newer techniques of formulation, quality control and standardization of drugs, other organizations in drug research, marketing, sales and administration.
- (4) To develop and propagate novel ideas with a view to nourish Pharmacy professionalism among the graduates.

Mission:

The program aims at producing professionally competent graduate pharmacists to meet the need of national and global healthcare systems, and enhance multi-disciplinary research and collaboration for sustainable development of the society.

Principal objectives

Some importance points of ordinance for semester system for Bachelor of Pharmacy Degree

Admission Requirement

Students seeking admission to pursue the course for the degree of Bachelor of Pharmacy with Honours should have passed both the SSC & HSC with at least second division or total CGPA 7.5 from Science group having GPA 3.5 (A-) in Chemistry, Physics, Biology and Mathematics. Besides, students who have passed 5 subjects in 'O' level and 2 subjects in 'A' level from science background with Chemistry in 'A' level and Chemistry, Physics, Mathematics and Biology in 'O' level are also eligible for admission in B. Pharm program.

Course curriculum

The Department of Pharmacy has designed the courses for Bachelor of Pharmacy, B. Pharm (Hons.) for a 4 years program consisting of 8 semesters with 160 credits to provide with in-depth knowledge in pharmacy and related fields. Academic Session for all undergraduate programs shall extend over a period of 4 (four) academic years. One academic year is divided into two semesters beginning from January. Each semester will be of 13 weeks for effective class teaching, 2 weeks preparatory leaves and three weeks semester end examination. For 2 classes per week and 3 classes per week for 2 credits and 3 credits respectively.

Distribution of Marks

The distribution of marks for the performance evaluation is as follows:

a). Theory Courses:

Section	Marks %
i. Class attendance	10
ii. Quiz/presentation	05
iii. In-course /tutorial exam/assignment	15
iv. Semester end final examination	70
Total Marks	100

b). Laboratory Courses:

Section	Marks %
i. Laboratory performance during lab hours	05
ii. Lab attendance	10
iii. Lab note book on experiment	05
iv. Viva-voce on experiment during practical exam	10
v. Semester end final examination	70
Total Marks	100

c). Industrial Tour/Filed work/In-plant Training Courses:

Industrial Tour/Filed work/In-plant Training work will be spread over two semesters (7th & 8th). The mark distribution for the Thesis / Project will be as follows:

Section	Marks%
i. Report of the Industrial Tour/Filed work/In-plant Training	50
ii. Overall performance in the Tour/Field work/Training	30
iii. Viva-voce/Quiz/Presentation	20
Total Marks	100

d). Project/Internship courses:

Section	Marks%
i. Presentation of the Project/ Internship	50
ii. Dissertation of the Project/ Internship work	30
iii. Overall Performance during the work	20
Total Marks	100

i. Class Attendance:

Class attendance is compulsory for every student. 10% of total marks in every course is allocated for attendance in classes including tutorials. The basis for awarding marks for attendance is as follows:

Attendance	Marks
90% and above	10
85% to less than 90%	9
80% to less than 85%	8
75% to less than 80%	7
70% to less than 75%	6
65% to less than 70%	5
60% to less than 65%	4
Less than 70%	0

If a student does not attend a minimum of 70% of the total classes including tutorials, s/he will not be allowed to take the final exam.

The year and semester-wise distribution of marks among the theory, practical, tutorial/class assignment, class attendance, viva-voce in-plant training/fieldwork, etc. are as follows:

First year 1st Semester

Course Code	Title of course	Theoretical/ Practical Marks (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-1101	Inorganic Pharmacy- I	70	15+5	10	100	2.00
PHARM-1103	Organic Pharmacy-I	70	15+5	10	100	3.00
PHARM-1105	Physical Pharmacy- I	70	15+5	10	100	3.00
PHARM-1107	Pharmacognosy- I	70	15+5	10	100	3.00
PHARM-1109	Pharmaceutical Microbiology and Immunology-I	70	15+5	10	100	3.00
PHARM-1111	Fundamental of Mathematics	70	15+5	10	100	2.00
PHARM-1104	Organic Pharmacy Lab	70	10+10	10	100	1.00
PHARM-1106	Physical Pharmacy- I Lab	70	10+10	10	100	1.00
PHARM-1108	Pharmacognosy-I Lab	70	10+10	10	100	1.00
Non-Credit	Islamic Studies/Bangladesh Studies				100	00
PHARM-1110	Oral Examination				50	1.00
Total =					1050	20.00

First year 2nd Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM - 1201	Inorganic Pharmacy-II	70	15+5	10	100	2.00
PHARM-1203	Organic Pharmacy-II	70	15+5	10	100	3.00
PHARM-1205	Physical Pharmacy- II	70	15+5	10	100	3.00
PHARM-1207	Physiology- I	70	15+5	10	100	3.00
PHARM-1211	Pharmaceutical Microbiology and Immunology-II	70	15+5	10	100	3.00
STAT-1213	Biostatistics and Computer Application	70	15+5	10	100	2.00
ENG-1215	English	70	15+5	10	100	2.00
PHARM-1202	Inorganic Pharmacy Lab	70	10+10	10	100	1.00
PHARM - 1206	Physical Pharmacy- II Lab	70	10+10	10	100	1.00
PHARM-1208	Physiology-I Lab	70	10+10	10	100	1.00
PHARM-1212	Pharmaceutical Microbiology and Immunology Lab	70			100	1.00
PHARM - 1210	Oral Examination				50	1.00
	Total=				1150	23.00

Second year 1st Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-2101	Pharmaceutical Analysis- I	70	15+5	10	100	3.00
PHARM-2103	Bio-Molecular Pharmacy	70	15+5	10	100	3.00
PHARM-2105	Physiology and Anatomy- II	70	15+5	10	100	3.00
PHARM-2107	Pharmacognosy- II	70	15+5	10	100	3.00
PHARM-2109	Basic Pharmaceutics-I	70	15+5	10	100	3.00
PHARM-2111	Pharmacology-I	70	15+5	10	100	3.00
PHARM-2102	Pharmaceutical Analysis- I Lab	70	10+10	10	100	1.00
PHARM-2106	Physiology and Anatomy-II Lab	70	10+10	10	100	1.00
PHARM-2108	Pharmacognosy-II Lab	70	10+10	10	100	1.00
PHARM-2110	Oral Examination				50	1.00
		Total=			950	22.00

Second year 2nd Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-2201	Pharmaceutical Analysis-II	70	15+5	10	100	3.00
PHARM-2203	Medicinal Chemistry-I	70	15+5	10	100	3.00
PHARM-2205	Hospital and Community Pharmacy	70	15+5	10	100	3.00
PHARM-2209	Basic Pharmaceutics-II	70	15+5	10	100	3.00
PHARM-2211	Pharmacology-II	70	15+5	10	100	3.00
PHARM-2202	Pharmaceutical Analysis-II Lab	70	10+10	10	100	1.00
PHARM-2204	Medicinal Chemistry-I Lab	70	10+10	10	100	1.00
PHARM-2212	Pharmacology-II Lab	70	10+10	10	100	1.00
PHARM-2210	Oral Examination				50	1.00
		Total=			850	19.00

Third year 1st Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-3101	Pharmaceutical Analysis- III	70	15+5	10	100	3.00
PHARM-3103	Medicinal Chemistry-II	70	15+5	10	100	3.00
PHARM-3105	Pharmaceutical Technology-I	70	15+5	10	100	3.00
PHARM-3107	Pharmaceutical Engineering-I	70	15+5	10	100	2.00
PHARM-3111	Pharmacology-III	70	15+5	10	100	3.00
PHARM-3104	Medicinal Chemistry- II Lab	70	10+10	10	100	1.00
PHARM-3106	Pharmaceutical Technology-I Lab	70	10+10	10	100	1.00
PHARM-3112	Pharmacology-III Lab	70	10+10	10	100	1.00
PHARM-3110	Oral Examination				50	1.00
	Total=				850	18.00

Third year 2nd Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-3201	Bio-pharmaceutics- I	70	15+5	10	100	3.00
PHARM-3203	Quality Assurance and Validation	70	15+5	10	100	2.00
PHARM-3205	Pharmaceutical Technology- II	70	15+5	10	100	3.00
PHARM-3207	Pharmaceutical Engineering-II	70	15+5	10	100	3.00
PHARM-3211	Pharmacology-IV	70	15+5	10	100	3.00
PHARM-3202	Bio-pharmaceutics-I Lab	70	10+10	10	100	1.00
PHARM-3206	Pharmaceutical Technology-II Lab	70	10+10	10	100	1.00
PHARM-3212	Pharmacology- IV Lab	70	10+10	10	100	1.00
PHARM-3210	Oral Examination				50	1.00
	Total =				850	18.00

Fourth Year 1st Semester

Course Code	Title of Course	Theoretical/ Practical Marks (%)	Tutorial/ Assignment + Oral Presentation (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-4101	Bio-pharmaceutics- II	70	15+5	10	100	3.00
PHARM-4103	Pharmaceutical Technology- III	70	15+5	10	100	3.00
PHARM-4105	Molecular Biology and Bioinformatics	70	15+5	10	100	3.00
PHARM-4107	Clinical Pharmacy and Toxicology	70	15+5	10	100	3.00
PHARM-4109	Pharmaceutical Marketing	70	15+5	10	100	2.00
PHARM-4102	Bio-pharmaceutics- II Lab	70	10+10	10	100	1.00
PHARM-4104	Pharmaceutical Technology-III Lab	70	10+10	10	100	1.00
PHARM-4106	Molecular Biology and Bioinformatics Lab	70	10+10	10	100	1.00
PHARM-4112	Hospital/Clinical Pharmacy / Training/ Pharmaceutical Industry In-Plant training				100	3.00
PHARM-4110	Oral Examination				50	1.00
	Total =				950	21.00

Fourth Year 2nd Semester

Course Code	Title of course	Theoretical/ Practical Mark (%)	Tutorial/ Assignment + Oral Presentation Marks (%)	Class Attendance Marks (%)	Total Marks	Credits
PHARM-4201	Cosmetology	70	15+5	10	100	3.00
PHARM-4203	Biotechnology and Genetic Engineering	70	15+5	10	100	3.00
PHARM-4205	Pathology	70	15+5	10	100	3.00
PHARM-4207	Drug Regulatory Affairs	70	15+5	10	100	3.00
PHARM-4209	Pharmaceutical Management	70	15+5	10	100	3.00
PHARM-4202	Cosmetology Lab	70	10+10	10	100	1.00
PHARM-4204	Biotechnology and Genetic Engineering Lab	70	10+10	10	100	1.00
PHARM-4212	Project/Internship Dissertation/ Presentation and Report				100	4.00
PHARM-4210	Oral Examination				50	1.00
	Total =				850	22.00

Syllabus in Details

Program Name: B. Pharm. (Hons.)	Year: 1 st (First)	Semester: 1 st (First)
Course Code: PHARM-1101	Course Title: Inorganic Pharmacy-I	
Course Credit: 2.00	Full Marks: 100	

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Develop student's knowledge on the basic principle of atomic structure and classification of elements.
- Develop knowledge about the pharmaceutical importance of periodic table & various elements.
- Grow student's knowledge about various chemical bonds & hybridization.
- Develop knowledge on the basic principle of redox reaction.
- Develop knowledge about the key features of coordination compounds oxidation and coordination numbers, ligands, chelates, bonding, stability of complexes.
- Grow student's knowledge about alkali, alkaline earth metals and halogen as well as their application.
- Develop knowledge on the basic principle of acid & base.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- To acquire practical knowledge and skills about identification techniques of different cations, anions or radicals in inorganic drug molecules.
- To pick up efficient knowledge about various elements in pharmaceutical products.
- To acquire hands on skill about the experimental techniques for making the corresponding inorganic salts of organic drug molecules with the aim to enhance their aqueous solubility.
- To gain knowledge on the stability of drugs in the point of view of oxidation-reduction process.
- Describe "coordination complex" and "ligand", oxidation state, isomerism & shapes of coordination complex.
- To obtain knowledge about the role of various metals & halogens in pharmaceutical products.
- To acquire hands on skill about the experimental techniques for acid-base related test of drugs,

Course details:

1. **Structure of Atoms:** Fundamental particles, origin of spectral lines and elementary treatment of theories of atomic structure, quantum numbers, De-Broglie's relationship, Heisenberg uncertainty principle, Pauli exclusion principle, Hund's rule, Aufbau principle, shapes of s, p, d, f orbitals.

2. **Classification of Elements:** Electronic structure of atoms, modern periodic table and periodic law, variation of periodic properties within periods and groups, ionization potential, electron affinity, electronegativity, usefulness and limitation of periodic table.
3. **The Chemical Bonds:** Electronic concept of valency, different types and formation of chemical bonds, e.g., ionic, covalent, co-ordinate covalent, metallic, hydrophobic, Vander Waal's force, hydrogen bond, etc., concept of atomic orbital, theories of covalent bonding and hybridization.
4. **Oxidation Reduction Reactions:** Definition, oxidation number, equivalent weight of oxidant and reductant, decomposition of drugs by redox reaction, ion electron method of balancing equation, importance and determination of redox potential.
5. **Co-ordination Compounds:** Definition, Werner's theory, electronic interpretation, structures of co-ordination compounds, valence bond theory and hybridization approach.
6. **Alkali, Alkaline earth metals and Halogen:** Electronic configuration, Physical and chemical properties of alkali, alkaline earth metals and halogens including their pharmaceutical applications.
7. **Basic concept on acids, bases, salts and pH:** Definitions, various theories of acids & bases, classification of acids, bases & salts, strength of acids & bases, determination of strength gradient of acids & bases.

Recommended books:

- | | |
|----------------------------------|---|
| 1. F.A. Cotton & G. Wilkinson | : Advanced Inorganic Chemistry |
| 2. B.R. Puri and L.R. Sharma | : Principles of Inorganic Chemistry |
| 3. E.S. Gilreath | : Fundamental Concepts of Inorganic Chemistry |
| 4. S.Z. Haider | : Introduction to Modern Inorganic Chemistry |
| 5. R.D. Madan | : Modern Inorganic Chemistry |
| 6. S. Gilreath | : Fundamental Concepts of Inorganic Chemistry |
| 7. F A Cotton & G. Willkinson | : Basic Inorganic Chemistry |
| 8. Satya Prakash, Tuli and Madan | : Advanced Inorganic Chemistry |

*** Other books will be indicated by respective teachers**

Program Name:	B. Pharm. (Hons)	Year: 1 st (First)	Semester: 1 st (First)
Course Code:	PHARM-1103	Course Title: Organic Pharmacy-I	
Course Credit:	3.00	Full Marks: 100	

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Develop basic knowledge on Organic Chemistry and understand the structure of molecules and their properties.
- Develop efficient knowledge about aliphatic & aromatic compounds for the preparation of drug & their activity.
- Develop knowledge for synthesis, properties and use of various heterocyclic compounds in pharmaceutical industries.
- Develop student's knowledge on the basic principle of various reaction mechanism.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- To understand various properties of organic molecules.
- To explain structure and synthesis of alkane, alkene, and alkyne.
- To discuss chemical properties of organic compounds with basic functional groups namely aldehyde, ketone, and carboxylic acid and the synthesis of essential drug molecules.
- To comprehend various heterocyclic compounds and their pharmaceutical application.
- To understand various reaction mechanisms in terms of addition, substitution, elimination and rearrangement reaction

Course details:

1. **General Introduction:** Historical background of organic chemistry, Basic concepts of electronegative polarity (polar and non-polar solutes), Ionization, Carbonium ions, Carbanion ions, Hydride, Protons, Free-radicals, Hydrogen bonding, Inductive effect, Electrophile, Nucleophile, Acids, Bases, etc.
2. **Chemistry of Aliphatic Compounds:** Introduction, Nomenclature, Methods of preparation, Physical and Chemical properties and applications of Hydrocarbons, Alcohols, Aldehydes, Ketones, Ester, Ethers, Amines, Amides and Carboxylic acids.

3. Chemistry of Aromatic Compounds:

- a. Aromaticity, Resonance and Orientation
- b. Preparations, Properties, Reactions and Pharmaceutical importance of phenols, Sulfonic acid, Carboxylic acid, Benzylaldehyde and Diazonium compounds.

4 Chemistry of heterocyclic Compounds: Definition of heterocyclic compounds, Nomenclature, Structure, Chemistry and synthesis of five-membered Furan, Thiophene, Pyrrole, Indole and its derivatives, Structure, Chemistry and synthesis of six membered rings; Pyridine, Quinoline and Isoquinoline and its derivatives, Pharmaceutical applications of five-membered and six membered heterocyclic compounds.

5. Reaction mechanisms:

- a. Addition reaction: Electrophilic; nucleophilic and free-radical; 1,2- and 1,4- addition.
- b. Substitution reaction: Unimolecular (SN1) and bimolecular (SN2), stereochemistry of SN1 and SN2 reaction, free-radical and intermolecular nucleophilic substitution.
- c. Elimination reaction: Unimolecular (E1) and bimolecular (E2), stereochemistry of elimination reaction.
- d. Rearrangement reaction: Hofmann, Claisen, Sigmatropic and Fries rearrangement.

Recommended books:

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|--------------------------------|---|
| 1. B.S. Bahl & Arun Bahl | : A Text Book of Organic Chemistry |
| 2. R.T. Morrison & R.N. Boyd | : Organic Chemistry |
| 3. Andrew Streitwieser | : Introduction to Organic Chemistry |
| 4. I.L. Finar | : Organic Chemistry Vol. I and II |
| 5. T.W.G. Solomon | : Organic Chemistry |
| 6. Clarke, Hans Thacher | : Practical Organic Chemistry |
| 7. S. Pine | : Organic Chemistry |
| 8. R.W.Griffin | : Modern Organic Chemistry |
| 9. J.D. Robert & M.C. Casserie | : Modern Organic Chemistry |
| 10. Fieser & Fieser | : Advanced Organic Chemistry |
| 11. B. S. Bahl and Arun Bahl | : Advanced Organic Chemistry |
| 13. Peter Sykes | : Reaction Mechanism in Organic Chemistry |
| 14. F.A. Carey | : Advanced Organic Chemistry |
| 15. Ashutosh Kar | : Medicinal Chemistry |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.)

Year: 1st (First)

Semester: 1st (First)

Course Code: PHARM-1105

Course Title: Physical Pharmacy-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- To describe the basic principle of gaseous laws & properties.
- To explain the law and systems of thermodynamics.
- To comprehend phase rules and their various system.
- To describe the ionic & chemical equilibrium.
- To understand of the basic principles of solutions and buffer solution.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- To discuss about the ideal gas behavior and chemical equilibrium that are essential to control production rate and process of chemicals.
- To assimilate various laws of thermodynamics for efficient and non-polluting production of drugs.
- To illustrate the units and factors for preparation of solutions.
- To describe phases, systems and their components.
- To explain about the practical applications of acidimetric-alkali metric analysis.
- To comprehend ionic and chemical equilibria for industrial production.

Course details:

1. **Properties of Gases:** Gas laws, diffusion of gases, kinetic theory of gases, Van der Waal's equation, critical phenomena, continuity of state, principle of corresponding states and the reduced equation of states, liquefaction of gases, uses of liquefied gas.
2. a) **Thermodynamics:** System, state and state functions, first law of thermodynamics, reversible, irreversible, isothermal and adiabatic changes, enthalpy, internal energy, molar heat capacity, second law of thermodynamics, Carnot's cycle, entropy, Free energy, Gibb's free energy, Gibbs Helmholtz equation, third law of thermodynamics.
(b) Thermo chemistry: Exothermic and endothermic reactions, thermochemical equation, heat of reaction, Laplace's and Hess's laws and its applications, bond energies.

2. **Solutions:** Units of concentration, Henry's law and distribution law and colligative properties.
3. **Phase rule:** Phase, component and degree of freedom, one component system (water and sulfur), two component systems (liquid-liquid, liquid-vapor) eutectic systems and dilution of completely immiscible systems.
5. **Ionic Equilibria:** Definition, Ostwald's dilution law, dissociation theory, ionization of water, common-ion effect, ionization constants of acid and bases, ionization of polyprotic electrolytes, solubility products and its application in pharmacy.
6. **pH, Buffer and salt hydrolysis:** Relative strengths of acids and bases, pH scale and its limitations, pH of weak acids and bases, degree of hydrolysis and hydrolysis constant, buffer equation, buffer capacity, buffer in pharmaceutical and biological systems, buffered isotonic solutions, methods of adjusting tonicity and pH, application of pH, buffer and salt hydrolysis in pharmacy.
7. **Chemical Equilibria:** Law of mass action, criteria of chemical equilibrium, application of law of mass action to homogenous and heterogeneous equilibrium, factors affecting equilibrium, Gibb's free energy change for chemical equilibria, Le-Chatelier's principle and its industrial application.

Recommended books:

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|---------------------------------------|------------------------------------|
| 1. M. M. Haque and M. A. Nawab | : Principles of Physical Chemistry |
| 2. A. Martin and J. Swarbrick | : Physical Pharmacy |
| 3. P.W. Atkins | : Physical Chemistry |
| 4. K.K. Sharma and L.K. Sharma | : A Textbook of Physical Chemistry |
| 5. B.S. Bahl, D.G. Tuli and Arun Bahl | : Essentials of Physical Chemistry |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 1st (First)
Course Code: PHARM-1107 **Course Title:** Pharmacognosy-I
Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- To develop knowledge about identification, collection of medicinal plants and preparation of crude drugs for Unani, Ayurvedic and Herbal medicines.
- To comprehend various authentic source of formula of drugs.
- To uplift the knowledge of extraction of active components with different pharmacological activities for drug discovery and further research.
- To encourage the local community for commercial cultivation of medicinal plants contribute to socio-economic development of the country.
- To uplift the knowledge of carbohydrate and related compound for use in medicinal preparation.
- To understand the properties, biosynthesis and use of alkaloid drugs.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- To know the background of pharmacognosy and the scope and opportunity of pharmacy profession.
- To get the complete information of both official and unofficial drugs and can help the community to provide minimum drug knowledge.
- To explore the scientific basis of traditional systems of medicines and treatment.
- To explore the scientific basis of indigenous medicinal plants for drug discovery and steps can be taken to develop awareness among people about the necessities of cultivation and conservation of such medicinal plants.
- To help students about research with targeting specific plant parts for drug discovery.
- To gain knowledge about cultivation, collection, preparation of crude drugs for the market with maintaining quality. This ultimately will encourage the local community for commercial cultivation of indigenous medicinal plants for socio-economic development of the country.

Course details:

1. **Introduction:** Definition, scope, historical background and relation to other disciplines.
2. **Drug Literatures and Publications:** Pharmacopoeia, pharmaceutical codex, formulary, index, and

official, non-official, unofficial and INN drugs (new drugs).

3. **Crude Drugs:** A general view of their origin, classification, evaluation of crude drugs, distribution, cultivation, collection, drying, storage, commerce and quality control.
4. **Phytochemistry:** Extraction, separation and detection of plant metabolites; basic principles of chromatography.
5. **Lipids:** Definition, classification, properties and extraction of
 - a) Plant origin: Castor oil, coconut oil, linseed oil, olive oil, peanut oil and chaulmoogra oil.
 - b) Animal origin: cod liver oil, shark liver oil and halibut liver oil.
 - c) Waxes.
6. **Carbohydrate and Related Compounds:** Definition, classification, properties and biosynthesis.
 - a) Monosaccharides and oligosaccharides: Sucrose, dextrose, glucose, fructose etc.
 - b) Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose, etc.
 - c) Gums and mucilages: Tragacanth, acacia, sodium alginate, agar etc.
7. **Alkaloids:** Definition, nomenclature, classification, distribution, properties, test, extraction and biosynthesis. Study of the following alkaloidal drugs: a) areca, conium b) lupinus and c) ephedra and colchicum.

Recommended books:

- | | |
|--|---|
| 1. E. P. Claus and V.E. Tyler | : Pharmacognosy |
| 2. V.E. Tyler, L.R. Brady & J.E. Robbers | : Pharmacognosy |
| 3. W.C. Evans | : Trease and Evan's Pharmacognosy |
| 4. Mohammed Ali | : Textbook of Pharmacognosy |
| 5. K. Raghunathan and Roma Mitra | : Pharmacognosy of Indigenous Drugs Vol. I & II |
| 6. M. A. Ghani | : Text book of Pharmacognosy, Part - 1 |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.)

Year: 1st (First)

Semester: 1st (First)

Course Code: PHARM-1109

Course Title: Pharmaceutical Microbiology and Immunology-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Learn the history and the biochemistry of bacteria.
- Apply the knowledge of microbiology in Pharmaceutical Science.
- Ensure Biological safety and safe preservation of drugs/pharmaceutical products and workplace.
- Illustrate bacteria, identifying major bacterial structures, characteristics & classification.
- Develop knowledge about viruses and other microbes like fungi, protozoa etc.
- Comprehend basic knowledge of immunity and antibody.
- Apply the knowledge of microbiology in Pharmaceutical Science.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Learn time wise development and practice of microbiological sciences and its relation with pharmaceutical microbiology.
- Demonstrate the knowledge of bacterial biology and apply microbiological processes.
- Prepare, grow & preserve different bacterial strains of both aerobic and anaerobic type.
- Identify microbial spoilage and apply measures to protect pharmaceutical products from spoilage.
- Describe viruses and other microbes as well as their infected diseases.
- Understand basic immunity and antibody with their classifications.

Course details:

1. **Introduction:** Historical development, scope of microbiology with special reference to pharmaceutical sciences.
2. **Microscopy:** Bright field, dark field, fluorescence, phase contrast and electron microscopy. Microscopic examination of microorganisms, wet mount and hanging drop techniques. Microbial staining.
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.
- f) Microbial metabolisms: Introduction, biogenesis, anabolism, catabolism, metabolic versatility of organisms, enzymes, energy production by aerobic & anaerobic processes, fermentation processes.

4. Virus:

- a) General properties, classification and nomenclature, morphology, multiplication and cultivation.
- b) Bacteriophage: Morphology and life cycle, virus & diseases, applications in life sciences.

5. Fungi, Rickettsia, Protozoa and Actinomycetes:

- a) Fungi- Pharmaceutical importance, characteristics, morphology, sexual & asexual reproduction, cultivation, classification of fungi, some fungi of special interest such as Penicillium, Candida, Aspergillus, Rhizopus; diseases caused by fungi.
- b) Rickettsia and actinomycetes: Occurrence, morphology, reproduction, classification, characteristics of major groups, pathogenesis and importance in pharmacy.
- c) Protozoa: Occurrence, morphology, reproduction, classification, characteristics of major groups of protozoa.

6. Basic concepts of Immunology:

- 1. Introduction to immune system, nonspecific and specific compounds of the immune systems: Innate and acquired immunity, complement, self and non-self
- 2. Antibody: Classification, chemistry and function.

Recommended books:

- | | |
|--|---------------------------------------|
| 1. M.J. Pelczar, E.C.G. Chan & N.R. Kreig | : Microbiology |
| 2. Roger Y. Stainer | : General Microbiology |
| 3. R. Ananthanarayan & C. K. J. Paniker | : Textbook of Microbiology |
| 4. M. R. Choudhury | : Modern Medical Microbiology |
| 5. Ivan Roitt, J. Brostoff & David Male | : Immunology |
| 6. Abul K. Abbas, A.H. Lichtman & J.S. Pober | : Cellular and Molecular Immunology |
| 7. W.H. Elliott and D.C. Elliott | : Biochemistry and Molecular Biology |
| 8. S. J. Carter | : Cooper and Gunn's Tutorial Pharmacy |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 1st (First)

Semester: 1st (First)

Course Code: PHARM-1111

Course Title: Fundamental of Mathematics

Course Credit: 2.00

Full Marks: 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- To make students familiar with the mathematical applications so that they can use it in pharmaceutical calculations and applications with the theory so that at the end of the course students can be benefited by translating this knowledge for pharmaceutical calculations.
- To develop knowledge about various graphs and gradients used in pharmaceutical research.
- To comprehend various method of matrices.
- To understand methods of integration and differentiation.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Perform making graphical presentation of various raw data of pharmaceutical research using graph & gradient.
- Plot graphs and would be able to solve from different graphical equations..
- Demonstrate matrix and calculus.

Course details:

- 1. Graphs and Gradients:** (a) Rectangular coordinates, curve fitting gusting, First degree equation in both variables, determination of slope, intercept and points of intersection, equation in first degree in both x and y (circle), ellipse, rectangular hyperbola etc. (b) Exponential and logarithmic curves, graphical solution equation, graphical solution of simultaneous equation, (c) Arithmetic progression, geometric progression, permutation, combination, the binomial theorem and exponential theorem etc.
- 2. Matrices:** Addition, subtraction and multiplication of matrices, unit matrix, row transformation, determinants, inverse of a matrix, solution of equations by matrix.
- 3. Calculus:** (a) Rate of process, rules of differentiation, successive and partial differentiation, differentiation of a function, relation between the derivatives of inverse functions, (b) Rules of

integration: General properties of definite integrals, Simple definite integrals and reduction formula, integration as a summation, area under the curve, integration by partial fraction, graphical integration.

Recommended books:

- | | | |
|----|-------------------------------|---|
| 1. | B.C. Das, & B.N. Mukherjee | : Integral Calculus 2nd Edition |
| 2. | 2. B.C. Das, & B.N. Mukherjee | : Differential Calculus 2nd Edition |
| 3. | 3. Ayres F. & Meldeson | : Schaum's, outline of Calculus 4th Edition |
| 4. | 4. M.A. Rahman | : College Linear Algebra, 4th Edition |
| 5. | 4. B. K. Kapur | : Business Mathematics |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.)

Course Code: PHARM-1104

Course Title: Organic Pharmacy Lab

Course Credit: 1.00

Exam Duration: 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- Learn detail about organic compounds.
- Apply the knowledge of Carbon Chemistry in organic Chemistry for detection of organic compounds as well in pharmaceutical science.
- Ensure Systematic qualitative analysis of organic compounds

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Acquire practical knowledge and skills about detection of various elements in organic compound.
- Identify various functional groups of organic compounds.
- Prepare derivatives of organic compounds and determine melting points.

Course details:

Systematic qualitative analysis of organic compounds-

- (a) Detection of elements, N, S and Halogens.
- (b) Identification of functional groups
- (c) Determination of melting points and Preparation of derivatives
- (d) Industrial Tour in a Pharmaceutical plant (one day)

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 1st (First)
Course Code: PHARM-1106 **Course Title:** Physical Pharmacy-I Lab
Course Credit: 1.00 **Exam Duration:** 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- To determine the thermal behavior during the dissolution of sample salts based on their solubility in water through the use of a calorimeter and derive their solubility as a function of temperature.
- To determine the molecular weight by various methods.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Evaluate the molecular weight using chemical and Meyer's method.
- Determine the heat of solution and neutralization by calorimeter.
- Estimate the molar volume, molar gas constant etc.

Course details:

1. Determination of molecular weight of substances like CHCl_3 , CCl_4 by Victor Meyer's method
2. Determination of molecular weight of organic salts by chemical method.
3. Determination of heats of solution of simple salts by calorimeter.
4. Determination of heat of neutralization of strong acid with strong base calorimetrically.
5. Determination of molar volume of H_2 at S.T.P.
6. Determination of molar gas constant R.
7. Determination of heat of solution of sparingly soluble samples in water by measuring solubility as a function of temperature (application of Vants- Hoff equation).
8. Determination of distribution coefficients of benzoic acid between (i) hexane and water (ii) Ether and water.
9. Determination of distribution coefficients of succinic acid between water and ether.

Program Name: B. Pharm. (Hons.)

Year: 1st (First)

Semester: 1st (First)

Course Code: PHARM-1108

Course Title: Pharmacognosy-I Lab

Course Credit: 1.00

Exam Duration: 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- To develop knowledge about identification, collection of medicinal plants and preparation of crude drugs for Unani, Ayurvedic and Herbal medicines
- To uplift the knowledge of extraction of active components with different pharmacological activities for drug discovery and further research.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Identify medicinal and poisonous plants morphologically.
- Perform extraction of plants for medicinal components.
- Identify sugars by routine test of pharmaceutical chemistry.

Course details:

1. Study on some medicinal plants
2. Identification of plant leaves- their botanical name, nature and medicinal uses
3. Collection and identification of some important medicinal plants and extraction of their medicinal components.
4. Study of some groups of unorganized white and off-white powdered and whole drugs.
5. Study of some poisonous plants of Bangladesh.
6. Identification of sugars (glucose, fructose, galactose, maltose, pantose, sucrose etc) by routine tests of organic Pharmaceutical Chemistry.

Program Name: B. Pharm (Hons.) **Year:** 1st (First) **Semester:** 1st (First)

Course Code: PHARM-1110 **Course Title:** Oral examination

Course Credit: 1.00 **Full Marks:** 100

Program Name:	B. Pharm. (Hons.)	Year: 1 st (First)	Semester: 2nd (Second)
Course Code:	PHARM-1201	Course Title: Inorganic Pharmacy-II	
Course Credit:	2.00	Full Marks: 100	

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Develop basic knowledge about the use of pharmaceutically important elements and salts.
- Understand the role of trace elements in pharmaceutical sciences.
- Explain the role of various essential compounds, solvents and glass wires.
- Know the preparation and application of various pharmaceutical agents/preparations like hematinic & dental preparations as well as dental & gastrointestinal agents.
- Comprehend the radioactivity and radiopharmaceuticals.
- Know the causes and remedy of environmental pollution for industrial and environmental safety.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Acquire knowledge about the cellular electrolytes and their role in various therapy.
- Illustrate the preparations and use of essential trace elements in pharmaceuticals.
- Demonstrate the stability of medicinal products in terms of antioxidants, solvents, glass and glass wires.
- Pick up efficient knowledge and skill about preparation and application of mentioned pharmaceutical products with the underlining causes of those physiological abnormalities.
- Describe the radioactivity and application of radio active compounds in pharmaceutical sciences.
- Take initiative for personal as well as environmental safety in pharmaceutical industry.

Course details:

1. **General Properties, Preparation and Uses of Pharmaceutically important elements and salts:** Intra and extra cellular electrolytes (Na, K, Ca and Cl ions.); Electrolytes in acid base therapy; electrolytes in replacement therapy, electrolyte combination therapy.
2. **Essential trace elements:** Essential trace elements and their preparations (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), applications of essential trace elements in pharmaceutical sciences.

3. **Antioxidants, solvents, pharmaceutically acceptable glass and glass wires**
4. **Hematinic preparations:** Various types of iron and iron compounds.
5. **Gastrointestinal agents:** Classification of inorganic gastrointestinal agents, systemic and non-systemic antacids, preparation and application of antacids, preparation and application of adsorbents and saline cathartics or laxatives.
6. **Dental Preparations:** Dental plaque and antiplaque agents, dental caries, fluorides and other anticaries agents (preparation and application), dentifrices, mouthwash.
7. **Topical agents:** Classification of topical agents, preparations and applications of different antimicrobial, astringent and protective agents.
8. **Radioactivity and radiopharmaceuticals:** Introduction, types of radiation and their properties, radioactive decay, half-life, average life, modes of radioactive decay, interaction of radiation with matter, measurement of radioactivity, radiation hazard and radiological safety, biological effects of radiation, control of radiation exposure, storage of radioactive materials, medical applications of radionuclides, official radioactive compounds and their importance, toxicity of radioactive isotopes.
9. **Environmental chemistry and environmental sciences:** Definition, causes of environmental pollution, a) Environmental Pollutants: Gases (SO_2 , SO_3 , CO , NO , HCl , NO_2 etc.), hydrocarbons, cigarettes, smokes, suspended particulate, pesticides, gasoline and industrial waste. Detrimental effects of pollutants. b) Heavy Metal toxicity: Mercury, arsenic, lead, iron and copper poisoning; prevention and treatment. (c) Water Pollution: Water pollutants, type, water treatment and purification.

Recommended books:

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|-------------------------|---|
| 1. S. Z. Haider | : Modern Inorganic Chemistry |
| 2. Z. E. Lee | : Inorganic Chemistry |
| 3. Rogers | : Textbook of Inorganic Pharmaceutical Chemistry |
| 4. Block and Wilson | : Inorganic, Medicinal and Pharmaceutical Chemistry |
| 5. Bentley and Driver's | : Textbook of Pharmaceutical Chemistry |
| 6. Discher | : Modern Inorganic Pharmaceutical Chemistry |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)
Course Code: PHARM-1203 **Course Title:** Organic Pharmacy-II
Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Understand heterocyclic compounds and learning properties and general methods of preparation of different heterocycles.
- Know carbohydrates and their classification, properties and various configurations.
- Develop knowledge on isomerism and its features in organic chemistry.
- Acquire knowledge of mechanism of action of various name reactions in organic pharmacy.
- Know the principles of conversions of organic compounds and factors that govern these reactions.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Illustrate the heterocyclic compounds and their preparations.
- Describe carbohydrates in terms of definition, classification, characteristics, configuration and their pharmaceutical applications.
- Demonstrate isomerism's in organic pharmacy.
- To explain different types of organic reactions, their mechanism of actions and factors that govern these reactions.
- Understand the various conversion methods of organic compounds.

Course details:

1. **A general introduction of heterocyclic compounds:** Characteristic properties and pharmaceutical importance of such compounds, Chemistry of Compounds containing C-S bonds (Mercaptans, Thioethers, Sulphonic acids and their derivatives) & C-P bonds- Preparations, Properties and uses.
2. **Chemistry of Carbohydrates:** Classification and characteristic reactions, Reducing sugars, Aldoses, Ketoses, A study of monosaccharides with special emphasis on the stereochemical relationship and configuration of glucose and fructose, Epimerization, Mutarotation, Disaccharides and Polysaccharides.
3. **Stereochemistry:** Types of isomerism, Asymmetric carbon atom, Specific and molecular rotation, Optically active compounds, Geometric and optical isomerism containing asymmetric carbon atoms,

Resolution of optical isomers, Determination of configuration of cis and trans compounds, Relative and absolute configurations, R and S configurations, Chemical and biochemical synthesis of asymmetric compounds.

4. **Organic Reaction Mechanisms:** Name reactions: Arndt- Eistertd, Baklelite, Baeyer-Villiger, Birch reduction, Clemmensen reduction, Darzens condensation, Diels Alder, Eschweiler-Clarke, Friedel-Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Michael, Meerwin- Pondorf- Verley, Oppenauer oxidation, Perkin, Reformatsky, Reimer- Tiemann, Vilsmeier- Haack, Witting and Wolf-Kishner reduction.
5. **Study of the Principle Conversions employed in Organic Process Industries:** Alcoholysis, Amination, Ammonolysis, Aromatization, Carboxylation, Condensation, Dehydration, Diazotization, Esterification, Fridel Crafts reaction, Halogenation, Hydroformylation, Hydrogenation, Hydrogenolysis, Hydration, Isomerization, Controlled Oxidation, Polymerization.

Recommended books:

- | | |
|--------------------------------|---|
| 1. B.S. Bahl & Arun Bahl | : A Text Book of Organic Chemistry |
| 2. R.T. Morrison & R.N. Boyd | : Organic Chemistry |
| 3. Andrew Streitwieser | : Introduction to Organic Chemistry |
| 4. I.L. Finar | : Organic Chemistry Vol. I and II |
| 5. T.W.G. Solomon | : Organic Chemistry |
| 6. Clarke, Hans Thacher | : Practical Organic Chemistry |
| 7. S. Pine | : Organic Chemistry |
| 8. R.W.Griffin | : Modern Organic Chemistry |
| 9. J.D. Robert & M.C. Casserie | : Modern Organic Chemistry |
| 10. Fieser & Fieser | : Advanced Organic Chemistry |
| 11. B. S. Bahl and Arun Bahl | : Advanced Organic Chemistry |
| 12. B. S. Bahl and Arun Bahl | : 2000 Solved Problems in Organic Chemistry |
| 13. Peter Sykes | : Reaction Mechanism in Organic Chemistry |
| 14. F.A. Carey | : Advanced Organic Chemistry |
| 15. Ashutosh Kar | : Medicinal Chemistry |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1205 **Course Title:** Physical Pharmacy- II

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Acquire knowledge on stability of drug products, stability testing and zone concept.
- Develop knowledge about rheology in pharmaceutical sciences.
- Understand Surface activity interfacial phenomena of pharmaceutical ingredients.
- Know about conductance, electrolysis, electrochemical cells, electrodes and their potentials.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Demonstrate the stability testing of medicinal products and zone concept.
- Describe the theory of rheology in pharmaceutical sciences.
- Understand the surface tension and phenomena of liquid pharmaceutical products.
- Illustrate the electrochemistry in terms of electrochemical cell, electrolysis, electrode potential and potentiometric titration etc.

Course details:

1. **Reaction Kinetics and Stability of Pharmaceuticals:** Chemical kinetics, Drug decomposition, Stabilization of medicinal products, Accelerated stability testing and catalysis. Zone concept, Environmental monitoring.
2. **Rheology:** Newtonian and non-Newtonian systems, yield value, plastic, pseudoplastic and dilatants flow, thixotropy. Determination of rheological properties, viscoelasticity, psychorheology, application in pharmacy. Rheological property of suspension.
3. **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.
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.

Recommended books:

- | | |
|----------------------------------|---------------------------------------|
| 1. M.M. Haque and M. A. Nawab | : Principles of Physical Chemistry |
| 2. B. S. Bahl and G. D. Tuli | : Essential of Physical Chemistry |
| 3. K. K. Sharma and L. K. Sharma | : A Text Book of Physical Chemistry |
| 4. S. Glasstone & D.Lewis | : Introduction to Electrochemistry |
| 12. F. Daniel & R.A. Alberty | : Physical Chemistry |
| 13. S.H. Maron & J.B. Lando | : Fundamentals of Physical Chemist |
| 14. P.C. Rakshit | : Physical Chemistry |
| 15. R.A. Alberty | : Physical Chemistry |
| 16. B.H. Mahan | : Elements of Chemical Thermodynamics |
| 17. Octave Levenspiel | : Chemical Reaction Engineering. |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)
Course Code: PHARM-1207 **Course Title:** Physiology and Anatomy-I
Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Develop students' knowledge on the basic structures and organization of cells, tissues, cell cycles regulations and relationship among the systems
- Develop the knowledge about the general function of the respiratory system, the structure and functions of the major organs related to respiratory system.
- Develop the understanding of blood composition, circulation, blood group determination, blood pressure, regulations of blood pressure, diagnosis and treatment of cardiovascular diseases.
- Develop the knowledge on the digestive system, digestive juice and absorption of digested food stuff.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Learn about the biology of human cell, human respiratory processes and its diseases.
- Demonstrate the biochemistry of blood, processes, functions and diseases of human cardiovascular system.
- Illustrate the composition and functions of lymphatic system.
- Describe the structure and function of digestive system.

Course details:

1. Cell, Tissue and Muscle System

- a) Cell: Structure and function, cell inclusions, division of cells.
- b) Tissue: Definition, classification, structures and functions of epithelial tissue, connective tissue, muscular tissue and nervous tissue.
- c) Body Fluid: Fluid compartments, volume and composition of ECF, ICF; Maintenance and regular of fluid volumes and their compositions.

2. Blood

- a) Plasma: Electrolytes, proteins and other organic constituents.

- b) Blood cells: Formation and destruction, cell constituents, functions of different blood cells.
 - c) Haemoglobin: Structure and function, haemoglobinopathy, thalassemia.
 - d) Anaemia: Causes and classification.
 - e) Blood coagulation and anticoagulation.
 - f) Blood group and transfusion.
3. **Lymph:** Composition, function, circulation and function, lymph nodes and lymphatics.
4. **Cardiovascular system**
- a) Heart: Structure and properties of cardiac muscles, conduction system of heart, cardiac cycle, heart sound, cardiac output and ECG.
 - b) Blood vessels: Type of blood vessels and their function.
 - c) Blood pressure (PHR): Measurements and regulation of PHR, control of PHR (neural and humoral).
 - d) Regional blood circulation: Pulmonary, hepatic, cerebral, capillary and coronary circulation.
5. **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.

Recommended books:

- | | |
|----------------------------------|--------------------------------------|
| 1. C. C. Chatterjee | : Human Physiology (Vol. I & II) |
| 2. Arthur C. Guyton | : A Textbook of Medical Physiology |
| 3. Chakrabarty, Ghosh and Sahana | : Human Physiology |
| 4. W. F. Ganong | : Review of Medical Physiology |
| 5. Selim Reza | : The Essentials of Human Physiology |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1209 **Course Title:** Pharmaceutical Microbiology and Immunology-II

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Know the basic feature of different natural microorganisms, reproduction cycle, pathogenic actions and treatment strategy against infectious disease by using the same processing microorganisms as well as rational uses of antibiotics therapy.
- Develop basic concepts on immunization and understanding different sterilization techniques for prepare sterile pharmaceutical products before marketing.
- Acquire knowledge about disinfectant and antiseptics.
- Develop student's knowledge on various types of contaminations and their remedy system, test & elements.
- Comprehend chemistry and mechanism of action of antibiotics and their assay.
- Understand the various aspects of microorganisms in pharmaceutical industries.
- Develop knowledge on immune response, cells involved in it and hypersensitivity.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Illustrate the sterilization process and application in pharmaceutical industries as well as various sterilization test techniques.
- Describe varieties of disinfectants, antiseptics and preservatives, their usages in pharmaceuticals as well as in everyday life.
- Learn about the various aseptic techniques used in pharmaceutical sciences.
- Explain methods of antimicrobial assay techniques.
- Understand the beneficial aspects of microorganisms and their control use in pharmaceutical industries.
- Illustrate the basic concept of natural immunity and immune suppressive agents, sterilization techniques for pharmaceutical products.

Course details:

1. **Sterilization and Sterility control:** Introduction to sterilization. Microbial kinetics of death. Dry heat

sterilization. Moist heat sterilization. Gas sterilization. Chemical sterilization and Sterilization by radiation. Filtration (liquids and air). Validation of sterilization, Depyrogenation, Depyrogenation temperature, Differences between sterilization and depyrogenation. Sterility testing techniques Sampling, Types of media used in sterility testing. Positive and negative controls. Pyrogen tests. Testing procedure for aqueous solutions, aqueous suspensions, powders, semi solid preparations, oils and ointments, ligatures and sutures, surgical dressings, equipment's. Miscellaneous tests: Immunological preparations and viral products.

2. **Disinfection and antiseptics:** Introduction to disinfection. Factors influencing disinfection. Chemical disinfectants and their modes of action. Disinfectant evaluation.
3. **Aseptic Technique:** Source of contamination, Classification of clean rooms, Air flow systems-conventional flow, unidirectional flow, laminar airflow units; Air filtration mechanisms, Fibrous filters and HEPA filters, Filter types, Temperature and humidity control, Protective clothing, Cleaning and disinfection, Commissioning test of clean and aseptic rooms, Routine and monitoring test, the operation of clean and aseptic rooms, Key factors in clean room operations, DOP test, Poly alpha olefin test.
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.
5. **Industrial Microbiology:** Ecology of microorganisms as it affects the pharmaceutical plant. Good manufacturing practice. Microbial spoilage and preservation. Miscellaneous pharmaceutical products of microbial origin (vitamins, amino acids, dextran, etc.), streptokinase.
6. **Basic concepts of Immunology:**
 - a) Introduction to immune response: Innate and acquired immunity, complement, self and non-self discrimination and source and chemistry of antigen.
 - b) Cells involved in immune system: macrophage and other antigen presenting cells, T cells, B cells, etc.
 - c) Hypersensitivity: Immediate and delayed type hypersensitivity reactions.

Recommended books:

- | | |
|---|--|
| 1. Pelczar, Kreig and Khan | : Microbiology |
| 2. Tortora, Funkee and Case | : Microbiology: An Introduction |
| 3. T.D. Brock | : Biology of Microorganisms |
| 4. Ivan Roitt, J. Brostoff and David Male | : Immunology |
| 5. Prescott and Dunn | : Industrial Microbiology |
| 6. Malcolm Harris | : Pharmaceutical Microbiology |
| 7. A J Salle | : Fundamental Principles of Bacteriology |
| 8. Cooper and Gunn | : Dispensing for Pharmaceutical Students |
| 9. Lachman and Whistriche | : Microbiology |
| 10. Russel and Hugo | : Pharmaceutical Microbiology |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)
Course Code: PHARM-1211 **Course Title:** Biostatistics and Computer Application
Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Learn methods of statistical sampling to conduct research.
- Acquire knowledge of measurement methods used in statistics.
- Familiar with significance test, pharmaceutical calculations to conduct experiments.
- Know the history and chronological development of computer.
- Make the students familiar with basic application software's of computer science
- Apply the acquired knowledge in pharmaceutical science.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Understand basic statistics and sampling methods.
- Perform statistical measurement with graph and diagrams.
- Calculate pharmaceutical dosages using statistical tools.
- Conduct various statistical tests.
- Illustrate the history, evaluation and organization of computer.
- Use various tools and application software.
- Apply the basic computer applications in Pharmaceutical Science.

Course details:

Biostatistics:

1. **Statistics:** Application in pharmacy, sample and population, simple and random sampling, sampling distribution and standard error.
2. **Measures of central tendency:** Mean (arithmetic, geometric and harmonic) median and mode.
3. **Graphical and Diagrammatic representation:** Graphs and diagrams.
4. **Measures of dispersion:** Range, mean deviation, co-efficient of variation and standard deviation.
5. **Basic idea of significance test:** Properties of distribution, distribution test and significance of

distribution test. The correlation of measurements and regression analysis.

6. **Bio-statistics and Pharmaceutical calculation:** Dosage calculation, Statistical methods utilized in pharmaceuticals, ANOVA, design of experiment.

Computer application:

1. **Computer:** History, classification and application in pharmaceutical analysis.
2. **Organization of computer:** A general review of INPUT/OUTPUT media and devices, functional parts and organization of CPU, hardware, software, batch processing, RAM, ROM, etc.
3. **Operating systems:** Introduction to DOS and Windows command.
4. **Computer packages:** Micro Soft-Word, Power Point, Excel and Outlook, Photoshop and Kekule.
5. **Application of Computer in Pharmacy:** Use of Internet for pharmacy education and Industrial pharmacy.

Recommended books:

- | | |
|---------------------------------|---|
| 1. S. P. Gupta | : Statistical Methods |
| 1. R. N. Shil and S. C. Debnath | : An Introduction to the theory of Statistics |
| 2. S.C. Gupta and V.K. Kapoor | : Fundamentals of Mathematical Statistics |
| 3. Jerrold H Zar | : Biostatistical Analysis |
| 4. Aptech | : Computer Books |
| 5. Noel Kalicharan | : An Introduction to Computer Studies |
| 6. H. L. Capron | : Computers |
| 7. Goldschlager and Lister | : Computer Science- A modern introduction: |
| 8. V Rajaraman | : Fundamentals of Computers: |
| 9. Graham Taylor | : Work Out Computer Studies GCSE |
| 10. Peter Norton's | : Introduction to Computers |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)
Course Code: PHARM-1213 **Course Title:** English
Course Credit: 2.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10%
Quiz/presentation	05%
In-course/tutorial /assignment	15%
Semester end final examination	70%

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to –

- Help students learn about the major skills of English language and their proper applications in everyday life
- Develop students' communicative competence.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Know how to develop vocabulary
- Learn about the proper use of parts of speech
- Apply how to transform one part of speech into another part
- Verify the structures of basic sentences
- Identify different clauses and phrases
- Differentiate between clauses and phrases
- Frame W/H questions
- Learn about the elements of reading
- Understand the reading strategies
- Understand the art of good speaking
- Apply practically different notions of speaking
- Differentiate between academic writing and non-academic writing
- Identify the mechanics in writing
- Apply practically different structures of writing

Course details:

1. **Development of Vocabulary:** Processes of Word Formation and Transformation; Proper use of parts of speech.
2. **Sentence Structure:** Structures of Basic Sentences, Identification of Clauses and Phrases, Joining sentences, Transformation of Sentences, Framing W/H Questions.

3. **Reading and Understanding:** Perspectives on reading comprehension; Elements of reading: vocabulary, syntax and meaning.
4. **Reading strategies:** intensive and extensive reading; scanning and skimming; prediction and inference; reader's expectation and interpretation; contextual understanding and understanding the whole text; effective note-taking.
5. **Development of Speaking skills:** Art of Good Speaking, Notions and Functions, Speaker-listener Rapport, Intonation and Stress.
6. **Development of Writing Skills:** Process of writing, Understanding Academic Writing: features and elements, Mechanics in Writing: Capitalization and Punctuation; Generating ideas for a writing task; Drafting and Supporting ideas with evidence; Integrating data and graphics in texts; Modes of writing, Writing tasks: Paragraph, Essay, Summary, Précis, Report, Abstract, Letter of Application, Assignment, Examination Paper.
7. **Development of Listening Skills:** Guide Lines for Developing Listening Skills, Role of a Good Listener, Listening Comprehension

Recommended books:

- | | |
|-----------------------------------|--|
| 1. Thomson, A.J. and Martinet | : A Practical English Grammar (with exercise books). |
| 2. Honorby | : A guide to patterns and Usage in English |
| 3. Sharpe, P.J. | : Barron's How to prepare for the TOEFL |
| 4. S. Ahmed | : Learning English, The Easy Way |
| 5. A.J. Thomson and A.V. Martinet | : A Practical English Grammar |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1202 **Course Title:** Inorganic Pharmacy Lab

Course Credit: 1.00 **Exam Duration:** 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- Acquire practical knowledge and skills about qualitative analysis of a mixture of compounds.
- Perform acid-base and oxidation-reduction titration.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Illustrate the qualitative analysis of mixture of compounds.
- Perform acid-base and oxidation-reduction titration.

Course details:

1. **Inorganic Qualitative analysis:** Systematic qualitative analysis of a mixture of compounds containing not more than four radicals.
Basic radicals: Ag, Cu, Pb, Hg, As, Sb, Fe, Al, Cr, Zn, Ni, Mn, Co, Ca, Ba, Mg, Na, K, NH₄
Acid radicals: CO₃, halides, citrates, SO₄, SO₃, NO₃, etc.
2. **Acid-Base Titration:** (i) Titrimetric methods for acid and base, (ii) Determination of Carbonate and bicarbonate in Washing soda.
3. **Oxidation Reduction Titration:** Quantitative separation and determination of:
 - (i) Cu⁺ (Volumetrically) and Ni⁺⁺ (Gravimetrically)
 - (ii) Fe⁺⁺⁺ (Volumetrically) and Mn⁺⁺ (Gravimetrically)
 - (iii) Cu⁺⁺ (Volumetrically) and Zn⁺⁺ (Gravimetrically)
 - (iv) Cu⁺, Fe⁺⁺ (Volumetrically) and SO₄⁻² (Gravimetrically) in a mixture

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1204 **Course Title:** Physical Pharmacy-II Lab

Course Credit: 1.00 **Exam Duration:** 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- Understand the evaluation of viscosity study of pharmaceutical products by viscometer.
- Comprehend the determination of velocity constant of the hydrolysis.
- Know about the determination of titration curve.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Determine the viscosity of liquid medicinal preparations.
- Evaluate the velocity constant of hydrolysis.
- Estimate the titration curve.
- Determine the solubility product of sparingly soluble salts.

Course details:

1. Determination of viscosity of pure liquids such as glycerin, alcohol and nitrobenzene using Ostwald viscometer.
2. Study of variation/viscosity of a liquid with temperature using Ostwald viscometer.
3. Determination of velocity constant of the hydrolysis of methyl-ethyl acetate catalyzed by HCL.
4. Determination of titration curve for the titration of a weak base-with a strong acid and a strong base with a weak acid conductometrically and hence-finding their strengths.
5. Determination of solubility product of a sparingly soluble salt in water by conductance measurement.
6. Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurement.
7. Construction of adsorption isotherm of a suitable acid from aqueous solution of charcoal.

Recommended Books:

- | | |
|-------------------------|---------------------------------------|
| 1. Findlay | : Practical Physical Chemistry |
| 2. Raghavon | : Experimental Physical Chemistry |
| 3. S.R. Palit | : Practical Physical Chemistry |
| 4. Khosla, Garg, Gulati | : Senior Practical Physical Chemistry |

Program Name: B. Pharm. (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1208 **Course Title:** Physiology-I Lab

Course Credit: 1.00 **Exam Duration:** 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- Learn about the microscopic technique.
- Understand the evaluation processes of various blood parameters.
- Comprehend the study of blood cells counting methods.
- Know the effects of chemicals on blood cells.
- Grow knowledge on bleeding and clotting time.
- Develop student's knowledge about factors governing blood clotting process.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Illustrate the features of microscopic technique.
- Describe the processes of study of blood cells.
- Estimate the different type of cells in blood.
- Examine the characteristics of hemoglobin.
- Count WBC, RBC and platelets.
- Determine bleeding and clotting time.
- Evaluate the effects of chemical agents on blood cells
- Determine the ESR rate.

Course details:

1. Study of Microscope
2. Microscopically study of blood cells
3. Different types of WBC, Erythrocytes and platelets
4. Examination of hemoglobin
5. Differential count of WBC
6. Total count of RBC and WBC
7. Determination of clotting and bleeding time
8. Examination of clot under the microscope
9. Effect of chemical agents of RBC
10. Fragility test of RBC
11. Determination of erythrocytes sedimentation rate
12. Examination of haemin crystals.

Program Name: B. Pharm. (Hons.) **Year:** 1st (First)

Semester: 2nd (Second)

Course Code: PHARM-1210

Course Title: Pharmaceutical Microbiology and Immunology Lab

Course Credit: 1.00

Exam Duration: 6 Hours

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Viva-voce on experiment during practical exam	10%
Semester end final examination	70%

Course Objectives: The objectives of the course are to –

- Develop student's knowledge on preparation of media and bacterial culture.
- Understand the identification and characterization process of bacteria and other microbes.
- Know about bacterial staining process.
- Comprehend the bacterial growth, isolation processes.
- Learn the antibiotic sensitivity test methods.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Explain bacterial preparation of bacterial media & culture,
- Identify & characterized bacteria as well as other microbes.
- Understand staining bacterial technique.
- Isolate bacteria from natural habitat.
- Illustrate bacterial growth curve.
- Perform antibiotic sensitivity test by disc diffusion method.

Course details:

1. Preparation of bacterial media
2. Culture of bacteria
3. Identification and characterization of bacteria
4. Staining of bacterial cells and spores
5. Preparation of pure cultures and its identification
6. Bacterial load counts
7. Identification and characterization of fungus.
8. Isolation of Bacteria from natural habitat.
9. Bacterial growth curve.
10. Investigation the bacterial load through serial dilution technique from supplied sample (Liquid/solid).
11. Antibiotic sensitivity test through disc diffusion method.

Program Name: B. Pharm (Hons.) **Year:** 1st (First) **Semester:** 2nd (Second)

Course Code: PHARM-1210 **Course Title:** Oral examination

Course Credit: 1.00 **Full Marks:** 100

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2101

Course Title: Pharmaceutical Analysis- I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- Teach students in qualitative and quantitative aspects of different analytic methods and techniques.
- Demonstrate the basic laboratory technique of titration.
- Know the concept of the oxidation reduction titration.
- Learn about complex formation reactions.
- Gain knowledge about non-aqueous acid base titrations.
- Determine moisture Content in Pharmaceutical Products.
- Learn about bioassay of antibiotics and vitamins.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Apply the concepts in various steps like sample preparation, routine quality control analysis, development and validation of analytical methods useful in pharmaceutical industry.
- Differentiate between an “endpoint” and an “equivalence point” in an acid-base titration and will be able to describe, by using chemical equations and equilibrium constants, the chemical change(s) that occur during a weak acid/strong base (or strong acid/weak base) titration.
- Calculate the potential of the titrated solution at any point during the titration and will be able to select the suitable indicator for a certain titration and also will be able to realize the wide applications of the redox reactions.
- Distinguish between simple complexes and chelates and understand the mechanism of complex formation reaction and the methods used for equivalent point detection.
- Understand the principle, theory, application and scope of non-aqueous Acid Base Titrations.
- Understand the principles and methods of water determination.
- Understand the principles and methods of bioassay and to ascertain the potency of a drug.

Course details:

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.
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. Indicators theories, selection and applications.
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.
4. **Complexometric Titrations:** Introduction, complexes and chelates, stability of complex ions, titrations based on complex formation types of complexometric titrations technique employed in titration, methods of end point detection, titration selectivity and masking reagents.
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. **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 detection and limitations.
7. **Principles of bioassay of antibiotics and vitamins:** Introduction, principles, tube dilution method, disc diffusion method, advantages and disadvantages.

Recommended Books:

- | | |
|-----------------------------|---|
| 1. Chatten | : Quantitative Pharmaceutical Analysis (Vol I & II) |
| 2. K. A. Connors | : A Textbook of Pharmaceutical Analysis |
| 3. A. I. | : Vogel Quantitative Inorganic Analysis (Vol. I & II) |
| 4. | : British Pharmacopeia |
| 5. | : United States Pharmacopeia and National Formulary |
| 6. A C. Moffat | : Clarke's Isolation and Identification of Drugs |
| 7. J. Bassett, R. C. Denney | : Textbook of Quantitative Inorganic Analysis |
| G. H. Jeffery & J. Mendham | |
| 8. M. Shah Nawaz Khan | : Assurance of Quality Pharmaceuticals |
| 9. M. S. Cooper | : Quality Control in the Pharmaceutical Industry (Vol. 1-3) |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2103

Course Title: Bio-Molecular Pharmacy

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- Provide general information about amino acids and proteins.
- Recognize and draw particular carbohydrate structures.
- Learn the fundamental role of lipids in diet, metabolism and basic terminology.
- Gain knowledge about nomenclature of nucleic acids.
- Learn detail about enzyme and coenzyme

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Understand the physicochemical properties of amino acids and proteins, acid-base properties of amino acids and peptide bond formation in amino acid.
- Know general structural elements of cyclic monosaccharides and disaccharides, and their implications for structure/function
- Recognize the different types of lipids, be able to distinguish saturated from unsaturated fatty acids, be able to understand the fatty acid biosynthesis and be able to recognize the steps of β -oxidation.
- Know how nucleotides are linked together to form nucleic acids and be able to describe how a new copy of DNA is synthesized and how RNA is synthesized from DNA and be able to gather knowledge of genetic engineering.
- Understand the chemistry, structure, mechanism of action of enzyme and coenzyme and be able to know the role of regulatory enzymes in controlling metabolic pathways and cellular responses.

Course details:

1. **Amino acids and Proteins:** Introduction, structure, acidity and basicity, isoelectric point, reactions and chemical synthesis of amino acids. Essential and nonessential amino acids, peptide synthesis and denaturation. Definition, classification, important reactions, sequence determination, test of purity, protein as drugs.
2. **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.

3. **Lipids:** Chemistry, biosynthesis of fats and fatty acids, catabolism, fatty acid cycle, β -oxidation, ketone bodies, ketosis, ketouria, ketoacidosis, lactic acid and acidosis, phosphoglycerides, bile salts.
4. **Nucleic Acids:** Chemistry of nucleic acids, bases, nucleosides, nucleotides, polynucleotides, nucleoproteins, RNA, DNA, Replication of DNA, codons, anticodons, polypeptides, genetic engineering and its application in Pharmacy.
5. **Enzymes and Coenzymes:** Chemistry, classification, catalytic activity, enzyme specificity, mechanism of enzyme actions, enzyme catalyzed reactions. Coenzymes- thiamine pyrophosphate, flavin coenzyme, TH₄ pantothenic acid, NAD⁺, NADPH, pyridoxal pyrophosphate, biotin, vitamin B₁₂ co-enzyme, etc.

Recommended Books:

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|---------------------------------------|--|
| 1. De Robertis | : Cell and Molecular Biology |
| 2. Stefan Surzycki | : Human Molecular Biology |
| 3. W.H. Elliott and Daphne C. Elliott | : Biochemistry and Molecular Biology |
| 4. P.C. Turner and M.R.H. White | : Instant Notes in Molecular Biology |
| 5. S.P. Vyas and V.K. Dixit | : Pharmaceutical Biotechnology |
| 6. K. Sambamurthy and A. Kar | : Pharmaceutical Biotechnology |
| 7. W. Crueger and A. Crueger | : Biotechnology, A Textbook of Industrial Microbiology |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2105

Course Title: Physiology and Anatomy-II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- Demonstrate knowledge about the nervous system
- Learn about the properties, functions and metabolism of fats, carbohydrates and proteins.
- Gain knowledge about the urinary system.
- Explain factors increasing heat production and various regulating factors of body temperature.
- Provide information about the parts of the respiratory system.
- Identify the major endocrine glands in the body.
- Explore the importance of reproduction in an organism's life cycle.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to learn-

- Understand the structure and function of neurons as well as nervous system and be able to distinguish the central nervous system from the peripheral nervous system.
- Describe metabolic pathway of fats, carbohydrates and proteins and physiological properties and functions of vitamins and minerals.
- Demonstrate the basic structures of excretory system and its role in maintenance of acid-base balance
- Understand the role of different glands in regulation of temperature in human body.
- Describe the functions of each part of the respiratory system and be able to describe how gas exchange occurs between the alveoli and pulmonary capillaries.
- Make a simple chart and identify the endocrine gland, the hormones it produces and a general function and be able to explain the roles of the endocrine system in maintaining homeostasis.
- Explain the role of different sex organs, its secretions and functions and associated diseases.

Course details:

1. Nervous system: Nerve cell-Properties of nerve, cells, nerve impulses and their transmissions

Nerve fibres: Types of nerve fibres, Origin and propagation of nerve impulse across nerve fibre, action

potential, units for measurement of nerve excitability, Synapse: Classification and properties of synapses and their functions. Reflex action: definition, classification and properties, principal division of nervous system; CNS, PNS, Different parts of CNS; principal motor and sensory paths of the CNS, Upper motor neurone and lower motor neurone. Sensory nerve ending: Different types of sensation, Muscle tone; Definition and regulation. Posture and postural reflex: Autonomic nervous system and its principal division, sympathetic and parasympathetic functions served by the sympathetic and parasympathetic nerves. Neurotransmitter.

2. **Metabolism:** Metabolism of fats, carbohydrates, proteins and nucleoproteins metabolism. Metabolic pathways of fats, carbohydrates and proteins. Enzymes, hormones, vitamins regulating the metabolic pathways; vitamins and minerals their physiological properties and functions.
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.
4. **Temperature control:** Heat production and heat dissipation, hypothalamus and nervous factors involved in body temperature regulation, function of skin.
5. **Respiratory System:** Functional anatomy of the respiratory system, mechanism of respiration, lung volumes and capacities, gaseous exchange and transport (O_2 and CO_2); nervous and chemical regulation of respiration; hypoxia-causes and classification; periodic (abnormal) breathing, Cheyne-Stokes breathing, Kussmaul breathing and breathing at high altitude.
6. **Endocrine glands:** Structure and functions of pituitary thyroid parathyroid, adrenal glands and pancreatic islets. Hormones secreted by the different endocrine glands and by the hypothalamus, normal and disordered functions of the different hormones. Regulation of the secretion of different hormones.
7. **Reproduction:** Structure and function of testis, ovary. Uterus and placenta. Menstrual and oestrous cycles Diagnosis of pregnancy, oestrogen, progesterone, androgens and gonadotropic hormones.

Recommended Books:

1. C. C. Chatterjee : Human Physiology (Vol. I & II)
2. Arthur C Guyton : Medical Physiology
3. W. F. Ganon : Review of Medical Physiology

*** Other Books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2107

Course Title: Pharmacognosy- II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn chemical structures in plants and pharmaceutical uses of different plant constituents.
- Know the source, characteristics and importance of different alkaloids.
- Gain knowledge about the chemistry, medicinal uses and methods of obtaining volatile oils.
- Provide knowledge about some poisonous plants and natural pesticides
- Gather a thorough knowledge about phenolic compounds and tanins.
- Provide information about resin and resin combinations.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Explain the characteristics of common botanical constituents and their physiological actions/interactions.
- Learn the biological and geographical sources of different alkaloids, their chemistry, biosynthesis and therapeutic application. The students will be able to perform different test to identify the presence of alkaloids.
- Learn a thorough knowledge on the chemistry of terpenoids, be able to understand the theoretical background on the biosynthesis of volatile oils and be able to learn the basic knowledge for the analysis of their chemical composition.
- Explain the chemical nature and characteristics of phenolic compounds and tanins and be able to perform different test to identify the presence of alkaloids.
- Understand the chemistry and characteristics of some resins.

Course details:

1. *Phytochemistry and Pharmaceutical uses of the following plant constituents:*

- a) Glycosides and glycoside-containing drugs: Classification and biosynthesis of glycosides.
- b) Phenols and phenolic glycosides.
 - i. Simple phenols: Vanilla and vanillin, capsicum.
 - ii. Tannins: Galls or nutgall, hamamelis.
 - iii. Antirsaquinone glycosides: Cascara sagrada; aloe, senna, rhubarb.

- c) Saponins, cardioactive drugs and other steroids.
 - i. Sarsaparilla root. Ginseng, Glycerhizia.
 - ii. Pentacyclic triterpenoid saponin: Liquorice root.
 - iii. Cardioactive glycosides: Digitalis, strophanthus, squill.
 - iv. Cyanogenic glycoside: Wild cherry, mustard.
 - v. Miscellaneous isoterpenoids: Gentain, valerian root, quassia, fish betries, santonica flower, Saffron.

2. **Alkaloids:**

- a) Classification and 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: Veretrum viride, aconite.
- h) Purine base: Coffee, tea and cocoa.

3. **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, juniper, cade.
- b) Alcohols: Coriander, sandalwood, rose.
- c) Esters: Peppermint, lavender, rosemary.
- d) Aldehydes: Cinnamon bark, lemon peel, lemon grass.
- e) Ketones: Spearmint, caraway; dill, camphor.
- f) Imidazole: Clove, thyme, cinnamon leaf, ajowan.
- g) Ethers: Fennel, nutmeg, eucalyptus, anise, cajunut.
- h) Peroxides: Chenopodium.
- a. Others: Wintergreen, bitter almond.

4. **Poisonous Plants and Natural Pesticides:** Datura, poison hemlock, water hemlock, ipomoea, tobacco. pyrethrum flower, derris and lonchocarpus, strychnine, neem, etc.

5. **Phenolic compounds and Tannins:** Chemical nature and test for tannins, some tannin containing drugs such as Nutgall and Catechu.

6. **Resin and Resin combinations (resin, oleoresin, oleo gum resin, balsam):** Jalap, Cannabis, Capsicum, Ginger, Myrrh, Tolu Balsam, and Benzoin.

Recommended Books:

- | | |
|-----------------------------|-----------------|
| 1. V E Tyler and Brady | : Pharmacognosy |
| 2. E P Clause and V P Tyler | : Pharmacognosy |
| 3. P Trease and W C Evans | : Pharmacognosy |
| 4. Mohammad Ali | : Pharmacognosy |

*** Other Books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2109

Course Title: Basic Pharmaceutics-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- Provide a general overview of preformulation studies and to develop the elegant, stable, effective and safe dosage form by establishing kinetic rate profile.
- Gain knowledge about the chemistry and physical properties of some pharmaceutical excipients.
- Provide an integrated view of the fundamentals of polymer science and engineering.
- Demonstrate the ability to complete pharmaceutical calculations accurately.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Identify and describe pre-formulation studies and be able to understand the Physico-chemical parameter of new drug substances.
- Design and prepare a safe, effective and stable formulation by using different pharmaceutical excipients.
- Understand the chemical structure of various polymers, methods of measuring the molecular weight, polymerization kinetics and the students will be able to know the pharmaceutical applications of polymer.
- Perform calculations concerning concentration expressions, density, ratio and proportion, percentage calculation, reducing and enlarging formula and the students will be able to extend their skills in handling of medical prescription.

Course details:

- 1. 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, pK_a determinations, pH solubility profile, effect of temperature, solubilization, partition co-efficient, dissolution, stability analysis, solution stability and solid state stability.
- 2. 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.

3. **Polymer Science for pharmaceuticals:** Pharmaceutical applications, physical, chemical and mechanical properties, molecular weight and distribution, polymer solution properties, plasticization and elastomers.
4. **Pharmaceutical calculation:** Mathematical principles, common and decimal fractions, exponents, power and root, logarithmic calculations, reducing and enlarging formula, ratio and proportion, percentage calculations, ratio strength, concentration measurement.

Recommended Books:

- | | |
|-----------------------------------|--|
| 1. Cooper & Gunn | : Dispensing for Pharmaceutical Students |
| 2. A. Martin and J. Swarbrick | : Physical Pharmacy |
| 3. E. W. Martin | : Husa's Pharmaceutical Dispensing |
| 4. E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| 5. L. Lachman, H.A. Lieberman | : The Theory and Practice of Industrial Pharmacy |
| 6. S. J. Carter | : Cooper and Gunn's Dispensing for Pharmaceutical Students |
| 7. H. C. Ansel and N. G. Popovich | : Pharmaceutical Dosage Forms and Drug Delivery Systems |
| 8. A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |
| 9. Sprowl | : American Pharmacy |
| 10. Remington's | : Pharmaceutical Sciences |
| 11. Husa & Martin | : Dispensing of Medication |
| 12. M. E. Aulton | : Pharmaceutical Practice |
| 13. Fishburn | : An Introduction to Pharmaceutical Formulations |
| 14. Polderman | : An Introduction to Pharmaceutical Productions |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM 2111

Course Title: Pharmacology-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- Provide information about the history, application and scope of pharmacology.
- Describe the basic scientific concepts and principles that serve as the foundational basement of the pharmacological sciences including pharmacokinetics; pharmacodynamics; drug absorption; and drug-drug interactions and provide the basis of drug nomenclature, the dose-response relationship, and general mechanism of actions of drugs.
- Provide a detail information of drugs that act on central nervous system.
- Give knowledge about gastric antacids.
- Provide theoretical knowledge of autocoids.
- Gain knowledge about drugs that used in Haemopoietic System.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Define pharmacology and be able to explain its scope and application.
- Explain how the 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 given patient.
- Learn the mechanism of action, side effects and toxicity of analgesic and antipyretics hypnotic-sedatives and C.N.S. stimulants.
- Describe the chemistry, pharmacokinetic parameters, classification, mechanism of actions and side effects of different gastric antacids.
- Explain the chemistry, pharmacokinetic parameters, mechanism of action and adverse effects of Histamines, antihistamines, serotonin and kinins.
- Explain the pharmacokinetic parameters, mechanism of actions and side effects of Anticoagulants, Iron, folic acid and vitamin B12.

Course details:

1. History and Scope of Pharmacology

2. General Pharmacology: Methods of drug administration, biological 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.

3. *Drugs Acting on CNS*

- a) Analgesic and antipyretics. (i) Non opoids (NSAID): salicylates and congeners. (ii) Opoids: natural and synthetic.
- b) Hypnotic-sedatives: Benzodiazepines, barbiturates, etc.
- c) C.N.S. stimulants: Amphetamine, caffeine, strychnine, xanthine derivatives.

4. *Gastric Antacids*: General consideration, chemistry, absorption, modification, distribution and excretion. Action and adverse effects of gastric antacids. Classification of antacids-aluminums 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) etc.

5. *Autocoids*

- 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 thromboxane.
- d) The kinins: Kallidins and bradykinin.

6. *Drugs Used in Haemopoietic System*: (a) Anticoagulants: Heparin, warfarin, dicumarol, Na- and K-oxalates and citrates. (b) Iron, folic acid and vitamin B₁₂.

Recommended Books:

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|----------------------|--|
| 1. Goodman & Gillman | : Pharmacological Basis of Therapy |
| 2. Meyer | : Medical Pharmacology |
| 3. Andres Goth | : Medical Pharmacology |
| 4. R. S. Satosker | : Pharmacology and Pharmcotherapeutics |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2102

Course Title: Pharmaceutical Analysis-I Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

Course Objectives: The objective of the course is to –

- Examine the different pharmaceutical preparations.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Determine the potency and calculate the amount of drugs present in respective pharmaceutical preparations.

Course details:

1. Assay of acetyl salicylic acid in aspirin tablets.
2. Determination of potency of penicillin tablets.
3. Non- aqueous assay of phenobarbitone tablets.
4. Determination of calcium in solid & liquid dosage form by complexometric titration.
5. Assay of promethazine hydrochloride.
6. Assay of aluminum hydroxide gel.
7. Assay of magnesium and aluminum from antacid preparation.
8. Determination of iodine value and saponification value.
9. Assay of NaHCO₃ from supplied sample.
10. Assay of milk of magnesia from the supplied sample.
11. **Industrial Tour in a Pharmaceutical plant (one day)**

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Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2106

Course Title: Physiology and Anatomy-II Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

Course Objectives: The objective of the course is to -

- Make students practically skilled on some basic concepts of physiology.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Learn practically the functions of body system and be able to estimate glucose level in human.

Course details:

1. Demonstration of the effects of temperature on toad heart.
2. Demonstration of the effects of stannous ligature on frog's heart
3. Demonstration of the effects of drugs on toad heart
4. Demonstration of the effects of electrolytes (Na, K, Ca etc.) on toad heart.
5. Recording of respiration by stethograph.
6. Effect of ptyalin of saliva on starch.
7. Collection of gastric juice: Tests for gastric acidity.
8. Estimation of blood sugar in normal person

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 1st (First)

Course Code: PHARM 2108

Course Title: Pharmacognosy-II Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

Course Objectives: The objective of the course is to -

- Provide practical knowledge about various pharmacognostic and phytochemical standards which will be helpful to ensure the purity, safety, and efficacy of this medicinal plant.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Explain the characteristics of different plant constituents and be able to perform thin layer chromatography to calculate retention factor (R_f) to identify polar and non- polar compounds

Course details:

1. Pharmacognostic study of a few selected powdered drugs
2. Chromatographic techniques: Analysis of plant extracts by thin layer chromatography.
3. Study of volatile oils and some volatile-oil containing drugs: Caraway, clove, Cinnamon, peppermint, etc.
4. Study of few important cardioactive drugs: Digitalis, strophanthus and squill.
5. Study of alkaloids and some alkaloid-containing drugs: Belladonna, stramonium, cinchona, rauwalfia, tea. Coffee, tobacco, ergot, ephedra, nux vomica and areca.
Separation of different drugs by thin layer chromatography

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second) **Semester:** 1st (First)

Course Code: PHARM 2210 **Course Title:** Oral examination

Course Credit: 1.00 **Full Marks:** 100

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM 2201

Course Title: Pharmaceutical Analysis- II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Teach students in qualitative and quantitative aspects of different separation techniques.
- To give basic knowledge on instrumental methods of chemical analysis.
- To give students a broad view of the subject of crystallography.
- Giving an idea on the recent methods bioassay.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Understand the chromatographic technique for the separation of a mixture.
- Understand and capable of performing basic chemical processes in an analytical laboratory and be able to develop knowledge pertaining to the appropriate selection of instruments for the successful analysis of complex mixtures.
- Understand the concept of crystal structures and symmetry, the physics of scattering and diffraction theory, experimental diffraction from single crystals, instrumentation and powder diffraction.
- Acquire knowledge about drug development and be able to know how to deal with experimental animals to estimate the potency of drugs.

Course details:

1. Separation Technique:

- a) Introduction, principles, procedures, theories of column chromatography, gel filtration techniques, thin layer chromatography, ion exchange chromatography, size exclusion chromatography, paper chromatography; methods of detection and applications.

2. Instrumental Methods of Analysis:

- a) **Absorption spectroscopy:** Visible, and UV spectroscopy.
- b) **Polarimetry:** Introduction. origin of optical rotation, molecular requirements for optical rotatory powered methods used in polarimetry instruction and application.
- c) **Fluometry:** Introduction, theory and principle fluorescence, and chemical structure spectrophotometry, application. factors influencing intensity of fluorescence and application of fluorometry in pharmaceutical analysis.
- d) **Conductometry:** Principle, apparatus and measurements, experimental details of conductometric titration and applications. Kohlrausch's Law.

e) **Potentiometry:** Principle, methods and applications.

f) **Amperometry:** Theory and technique of amperometric titration with dropping mercury electrode and applications, factor affecting current flow during analysis.

3. 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.

3. Bioassay: Prerequisites and development, errors in bioassay and how to overcome them. Statistical design of bioassay, method and determination of bioavailability.

Recommended Books:

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|---------------------------------|---|
| 1. L. G. Chatten | : Quantitative Pharmaceutical Analysis (Vol I & II) |
| 2. K. A. Connors | : A Textbook of Pharmaceutical Analysis |
| 3. A. I. Vogel | : Textbook of Quantitative Analysis (Vol. I & II) |
| 4. A. H Beckett & J B Stenlake | : Practical Pharmaceutical Chemistry Vol. I & II |
| 5. A.M. Knevel and F.E. DiGangi | : Jenkins Quantitative Pharmaceutical Chemistry |
| 6. T. Higuchi and E. | : Pharmaceutical Analysis |
| 7. V. Alexeyev | : Quantitative Analysis |
| 8. Douglas A Skoog | : Principles of Instrumental Analysis |
| 9. B.K. Sharma | : Instrumental Methods of Chemical Analysis |
| 10. R.M. Verma | : Analytical Chemistry, Theory and Practice |
| 11. Donald Pavia | : Introduction to spectroscopy |
| 12. | : British Pharmacopoeia |
| 13. | : United State Pharmacopoeia |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM 2203

Course Title: Medicinal Chemistry-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn the physico-chemical properties of a drug and the way to treat them.
- Give knowledge about stereochemical nomenclature and pharmaceutical importance of stereochemistry study.
- Provide a detail idea of some name reactions.
- Give knowledge about Chemistry, SAR, mechanism of action and synthesis of the some important drugs.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Recognise the biological properties, and acquire the therapeutic potential of drugs and be able to analyse the relationships between action and structural and physicochemical characteristics.
- Differentiate chiral and achiral molecules and be able to recognize and draw structural isomers (constitutional isomers), stereoisomers including enantiomers and diastereomers, racemic mixture, and meso compounds
- Understand the chemistry and pharmaceutical importance of some name reactions.
- Explain the Chemistry, SAR, mechanism of action and synthesis of the some important drugs.

Course details:

1. **Physicochemical properties of drug and their relation to biological activity**
2. **Stereochemistry:** Geometric isomerism of alkenes and cyclic compounds. cis trans and (E), (Z) systems of nomenclature, conformational isomers, conformation of open chain and cyclic compounds; chirality of molecules; enantiomer, diastereomer. racemic modification meso compound (R) and (S) configuration, sequence rule and optical rotation; stereoselective and stereospecific reaction, pharmaceutical importance of stereochemistry study.
3. **Name 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 Meerwein-Ponndorf-Verley reduction, Oppenauer oxidation. Perkin reaction. Reformatsky reaction, Reimer-Tiemann reaction. Wittig, and Wolf-Kishner reduction.

4. Chemistry, SAR, mechanism of action and synthesis of the following drugs:

- a. Alkaloids: Occurrence, isolation. Classification and properties and alkaloids. structure determination synthesis and physiological activities of ephedrine. nicotine. atropine and morphine.
- b. Terpenoids: Occurrence. isolation and classification, synthesis of geraniol. citral ionones and amyris.
- c. Steroids: Occurrence, isolation, classification, properties, structure determination, synthesis and physiological activities of some major steroids.
- d. Vitamins: Occurrence, isolation, classification, properties, structure determination, synthesis and biological functions of vit-A, vit-B and vit-C.
- e. Flavonoids: Occurrence, isolation, classification, properties, structure determination, synthesis and physiological activities of some major flavonols and isoflavones.

Recommended Books:

- | | |
|-----------------------|---|
| 1. Wilson and Gisvold | : Textbook of Organic, Medicinal and Pharmaceutical Chemistry |
| 2. Ashutosh Kar | : Medicinal Chemistry |
| 3. Graham L. Patrick | : An Introduction to Medicinal Chemistry |
| 4. Alfred Burger | : Medicinal Chemistry Vol. I & II |
| 5. E J Ariens | : Drug Designs Vol. I, II & III |
| 6. O P Agarwal | : Chemistry of Organic Natural Products Vol. I & II |
| 7. W O Foye | : Principles of Medicinal Chemistry |
| 8. Wilson and Gisvold | : A Textbook of Medicinal Chemistry |
| 9. Alfred Burger | : Medicinal Chemistry |

* Other Books will be indicated by respective teacher

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2205

Course Title: Hospital and Community Pharmacy

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn a detail idea of hospital pharmacy and the role of hospital pharmacists for better health outcomes.
- Introduce the students to what pharmacists do in the community practice environment.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

Understand the correct medicine supply including purchasing, stock- keeping and delivery of drugs, dispensing to In and Out patients and able to know the general rules of hygiene, the quality assured production, compounding of medicines, pharmaceutical counselling like drug information and clinical pharmacy services.

- Communicate appropriate information about medications, be able to manage medication therapy, be able to process medication orders completely, accurately and efficiently and be able to identify and retrieve any missing information upon receipt of a medication order.

Course details:

1. Hospital pharmacy:

- 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.
- Pharmacy and Therapeutics committee:** Description and purpose, membership and functions. Hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text.
- Investigational use of drugs:** Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.
- Purchasing and Inventory control:** Purchasing agent, purchasing procedure, control on purchases, storage, perishable inventory, physical inventory, perpetual inventory.
- 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, celing, regulations concerning narcotics, inspection of nursing drug cabinets.
- Dispensing to In and Out patients:** Drug distribution systems, dispensing of charge, non- floor

stock drugs, mobile dispensing unit, unit dose dispensing, new concepts. Dispensing to out patients, locality of out-patient dispensing area, dispensing routine, record keeping. Dispensing during off-hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call. Drug charges in hospitals, pricing, break- even point pricing.

- g) Manufacturing-bulk and Sterile: Control and budget, manufacturing facility and capacity, operating costs, quality control.
- 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.
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.

Recommended Books:

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

* Other Books will be indicated by respective teacher

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2209

Course Title: Basic Pharmaceutics-II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn the history, principle and ethics of Pharmacy Practice.
- Discuss the common particle sizes of pharmaceutical preparations and their impact on pharmaceutical processing/preparation.
- Gain knowledge of the terms and concepts of Solubility and Dissolution rate.
- Describe classifications of dispersed systems, based on the phases of the components and based on the size of the dispersed particles.
- Provide general information of pharmaceutical incompatibilities.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Know the history of pharmacy profession and ethical standards of pharmacy practice.
- Understand the concept of particle size as it applies to the pharmaceutical sciences, able to know the methods for determining particle size and be able to understand the role and importance of particle shape and surface area.
- Recognize factors that affect solubility, be able to describe the role of drug dissolution from dosage forms in drug bioavailability and be able to know the variables that affect the dissolution rate of drug particles.
- Describe the difference between homogenous and heterogeneous dispersions, and be able to describe the properties and list examples of colloidal dispersions and coarse dispersions.
- Understand the pharmaceutical incompatibilities and their method of correction.

Course details:

- 1. History and Principle of Pharmacy Practice:** History, code of ethics, pharmacopoeias, formularies and codex's officially recognized in Bangladesh.
- 2. Micro-metrics:** 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.

3. ***Solubility and Dissolution rate:*** Methods of expressing solubility, solubility of gases in liquids, solubility of liquids in liquids, solubility of solids in solids, solubility of solids in liquids, factors affecting solubility, dissolution rate of solids in liquids.
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.
5. ***Pharmaceutical Incompatibility:*** Definition, types of incompatibilities, example of physical, chemical and therapeutic incompatibilities and their method of correction.

Recommended books:

1. Cooper & Gunn's : Dispensing for Pharmaceutical Students
2. Sprowl : American Pharmacy
: Remington's Pharmaceutical Sciences
3. W J Husa & E W Martin : Dispensing of Medication
4. Aulton : Pharmaceutical Practice
5. Fishburn : An Introduction to Pharmaceutical Formulations
6. Polderman : An Introduction to Pharmaceutical Productions
7. Martindale : The Extra Pharmacopoeia
8. Bentley's : Textbook of Pharmaceutics
9. Cooper & Gunn : Tutorial Pharmacy

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2211

Course Title: Pharmacology- II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Describe basic concept of drug action.
- Learn a clear concept about different types of antibiotics and the agents that causes cancer.
- Learn about the drugs affecting the autonomic nervous system.
- Provide knowledge of drugs that affect a person's mental state.
- Provide knowledge of drugs affecting the kidney Function.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Explain the physicochemical nature and basic idea of drug action and be able to learn the receptor and non- receptor mechanisms of drugs and other mechanisms of drug antagonism
- Get a basic idea of the classification, chemistry, mode of action, structure-activity relationship, pharmacokinetics, indications and contraindications of different antibiotics and chemotherapeutic agents.
- Explain the chemistry, mode of action, pharmacokinetics, indications and contraindications of Para-sympathomimetic, Sympathomimetic, anti-muscarinic and ganglion stimulating and blocking agents.
- Explain the chemistry, mode of action, pharmacokinetics, indications and contraindications of psychotropic drugs.
- Understand the chemistry, mode of action, pharmacokinetics, indications and contraindications drugs affecting the kidney Function.

Course details:

1. **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-effector coupling and spare receptors, other mechanisms of drug antagonism.

2. **Antibiotics and Chemotherapeutic Agents:** Introduction, classification, chemistry, mode of action, structure-activity relationship, pharmacokinetics, indications, contraindications. Dose, adverse effects and drug interactions of the following individual class of drugs: i) Sulfa drugs. ii) Penicillins and Cephalosporins. iii) Tetracyclins, Chloramphenicol, Aminoglycosides and Macrolides. iv) Antifungal agents. v) Antileprosy drugs. vi) Miscellaneous antibacterial agents: a) Glycopeptide antibiotics. (b) Polymixin antibiotics. (c) Bacitracin. (d) Nitrofurantoin.
3. **Drug Acting on ANS:**
 - a) (i) Para sympathomimetic agents: Acetyl choline, Methacoline, Carbachol. (ii) Sympathomimetic drugs: Epinephrine, norepinephrine. (iii) Anticholinesterase agents: Physostigmine, Edrophonine. Organophosphorous compounds.
 - b) (i) Antimuscarinic Agents or Atropine Drugs: atropine sulfate, scopolamine hydrobromide, homatropine hydrobromide. (ii) Drugs inhibiting adrenergic nerves and structures innervated by them, Adrenergic blocking agents.
 - c) Ganglion Stimulating and Blocking Agents
4. **Psychotropic Drugs:** Classification, mode of action, SAR, pharmacological actions, indications, toxicities and contraindications of chlorpromazine, benzodiazepam, TCA, MAO inhibitors, etc.
5. **Drugs Affecting Renal Function:** Osmotic diuretics, carbonic anhydrase inhibitors, potassium sparing diuretics, high ceiling diuretics.

Recommended Books:

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|--|--|
| 1. Goodman & Gillman | : Pharmacological Basis of Therapy |
| 2. H P Rang, M. M. Dale and J. M. Ritter | : Pharmacology |
| 3. A Gilman, T W Rall, A S Nies | : The Pharmacological Basis of Therapeutics |
| 4. R S Satoskar and S D Bhandarkar | : Pharmacology and Pharmacotherapeutics Vol. I & II |
| 5. A. Goldstein, L Aronow and S M Kalman | : Principles of Drug Action, The Basis of Pharmacology |
| 6. B G Katzung | : Basic and Clinical Pharmacology |
| 7. F H Meyers, E Jawelz and A Goldfien | : Review of Medical Pharmacology |
| 8. Meyer | : Medical Pharmacology |
| 9. Goth | : Medical Pharmacology |
| 10. R. S. Satosker | : Pharmacology and Pharmcotherapeutics |

* Other Books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2202

Course Title: Pharmaceutical Analysis-II Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this theoretical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- Make students practically skilled on different pharmaceutical analysis.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Handle different analytical machine, be able to examine pharmaceutical preparations, be able to perform thin layer chromatography to calculate retention factor (R_f) to identify polar and non- polar compounds and be able to learn the saponification process.

Course details:

1. Pharmaceutical analysis of drugs using spectrophotometer, polarometer, thin-layer chromatography, non-aqueous titration etc.
2. Microbiological assay of vitamins and antibiotics
3. Determination of saponification and iodine values of fixed oils

Program Name: B. Pharm (Hons.)

Year: 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2204

Course Title: Medicinal Chemistry-II Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this theoretical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- Provide practical knowledge of drug synthesis.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Synthesize of different drugs in the laboratory.

Course details:

1. Synthesis of drug & drug intermediates
2. Paracetamol, Benzocaine, Aspirin, Phenacetin, PABA (Para amino-benzoic acid), Meta Nitro benzaldehyde, Ethyl para hydroxy-benzoate, Para Amino phenol, Methylsalicylate.

Program Name: B. Pharm (Hons.)

Year: 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2212

Course Title: Pharmacology-II Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this theoretical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- Provide practical knowledge about some pharmacological test method.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Perform some enzymatic and chemical method for the estimation of blood glucose and plasma protein, handling of experimental animal and provide an idea of different routes of administration.

Course details:

1. Estimation of blood glucose by enzymatic method
2. Estimation of blood glucose by chemical method
3. Estimation of plasma protein by enzymatic method
4. Estimation of plasma protein by burette method
5. Estimation of blood uric acid level by enzymatic method
6. Handling of experimental animals: mice and rat
7. Different routes of administration of drugs in experimental animals

Program Name: B. Pharm (Hons.)

Year: 2nd (Second)

Semester: 2nd (Second)

Course Code: PHARM-2210

Course Title: Oral examination

Course Credit: 1.00

Full Marks: 100

Program Name: B. Pharm (Hons.) **Year:** 3rd (Third) **Semester:** 1st (First)

Course Code: PHARM-3101 **Course Title:** Pharmaceutical Analysis-III

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- acquire knowledge about HPLC including its principle, instrumentation, normal phase and reversed phase HPLC.
- know about principles, column technology, detectors, analytical application of gas chromatography.
- advance student's knowledge on the basic principle of ¹H-NMR spectroscopy and ¹³C - NMR spectroscopy including introduction & theory, relaxation process, instrumentation etc.
- gather knowledge on mass spectroscopy.
- introduce student with the Principles of Infra-red spectroscopy, Theory-Molecular vibrations, Instrumentation, Finger print region.
- develop students knowledge on different type of radiation, radiation detection and their measurement, principles of Geiger-Muller and Scintillation counter.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- acquire the basic principle, instrumentation, and operational procedure of HPLC and identify different types of column.
- apply gas chromatography for separation and purification of drug, excipients, biological agents, natural products or synthetically derived compound.
- analyze IR, NMR and Mass spectra of known and unknown drugs.
- demonstrate an understanding of theory and practical applications of mass spectroscopy.
- identify spectral features of some classes of organic compounds.
- Differentiate between natural and induced radioactivity and to detect different type of radiation.

Course details:

1. **High Performance Liquid Chromatography (HPLC):** Principle, instrumentation, characteristics of stationary and mobile phase, normal phase and reversed phase HPLC, different types of column, column regeneration, isocratic and gradient elution, HPLC method development, solvent selection;

pharmaceutical application.

2. **Gas Chromatography:** Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.
3. **Nuclear Magnetic Resonance Spectroscopy:** ^1H -NMR spectroscopy: introduction & theory, relaxation process, instrumentation, Shielding and deshielding effects, chemical shift, Factors influencing chemical shift, Splitting of signals, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling. ^{13}C - NMR spectroscopy, basic principle and application of. 2D NMR spectroscopy.
4. **Mass Spectroscopy:** Introduction, theory, the mass spectrum, Instrumentation, determination of molecular formula, determination of molecular weight, McLafferty rearrangement, ionization technique, recognition of molecular ion, Metastable ions or peak, The nitrogen rule, fragmentation modes, applications.
5. **Infra-red spectroscopy:** Introduction, Principles of Infra-red spectroscopy, Theory-Molecular vibrations, Instrumentation, Finger print region, Sampling techniques, Factors influencing vibrational frequencies, Spectral features of some classes of organic compounds, Applications of Infra-red spectroscopy.
6. **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, radio activation and isotope dilution analysis, characterization, methodology and use of radioisotope in pharmaceutical research.

Recommended books:

- | | |
|-------------------------------------|--|
| 1. L. G. Chatten | : Pharmaceutical Chemistry (Vol. I &II) |
| 2. K. A. Connors | : A Textbook of Pharmaceutical Analysis |
| 3. A.I. Vogel | : Textbook of Quantitative Analysis |
| 4. A.H. Beckett, & J. B. Stenlake | : Practical Pharmaceutical Chemistry Vol. I & II |
| 5. A.M. Knevel & F.E. DiGangi | : Jenkins Quantitative Pharmaceutical Chemistry |
| 6. T. Higuchi & E. Brockman-Hanssen | : Pharmaceutical Analysis |
| 7. V. Alexeyev | : Quantitative Analysis |
| 8. Douglas A Skoog | : Principles of Instrumental Analysis |
| 9. B.K. Sharma | : Instrumental Methods of Chemical Analysis |
| 10. R.M. Verma | : Analytical Chemistry, Theory and Practice |
| 11. Donald Pavia | : Introduction to spectroscopy |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3103

Course Title: Medicinal Chemistry- II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Acquire knowledge about drug design, discovery, development and drug design for pharmacokinetics problems.
- Introduce of computational molecular modeling of drug design.
- To provide information regarding combinatorial chemistry and rapid parallel synthesis.
- provide students with a comprehensive introduction, chemistry, synthesis and therapeutic uses of clinically important drugs.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- design, discover and develop different types of small molecules such as sulfa drugs.
- Demonstrate the QSAR, phytochemical properties of drugs.
- Analyze the solid and liquid phase synthesis.
- Explain the synthesis and clinical uses of psychotropic drugs, anti-neoplastic drugs, hypnotics & sedatives agents, antihistamines, NSAIDS, antipyretic analgesics, cardiovascular drugs, local anesthetics and diuretics.

Course details:

1. Drug design: Definition, purposes and factors governing of drug design, interpretation of SAR of Small molecules (Sulfa drugs), and design of pharmaceutical dosage forms.

2. Drug discovery: Discovery of the new drugs without leads, Lead discovery strategies, Requirements for identification of lead Compounds, principle and development of rational drug design (Cimetidine) and Role of biotechnology in drug design.

3. Drug development: Objectives, Pharmacophore, Patterns and SAR of drug development from natural Sources, Modification Synthetic analogues (variation of Substituent's, Bioisosterism, Homologation, Chain Branching and ring variation). theory, different traditional and mechanism based approaches to drug design application of quantum mechanics, Computer aided drug designing (CADD) ,molecular modeling, Congeneric Series and Clinical evaluation importance.

4. Drug Design for Pharmacokinetics Problems: Metabolic blockers, Prodrugs, Sentry drugs, Search and destroy`drugs, Self-destruct drugs, Drug distribution and survival of drugs.

5. Introduction of Computational Molecular Modeling of Drug Design: Quantitative Structure Activity Relationships (QSAR): Physicochemical properties (hydrophobicity, electronic effects, steric factors, solvent accessible surface area etc), Application of QSAR (Hansch equation, Hammett relationships) on biological systems.

6. Combinatorial Chemistry and Rapid Parallel Synthesis: Introduction, various drug discovery processes, design, diversity, expression, methods & techniques, and applications of combinatorial syntheses on drug discovery. ii) Solid phase Syntheses: Introduction, various linkers, solid phase peptide synthesis (SPPS): principle, mechanism and application; heterocyclic synthesis. iii) Liquid phase combinatorial synthesis, Dendrimer: supported combinatorial chemistry.

7. Chemistry, Synthesis and Therapeutic Uses of the Following Drugs: a) Psychotropic drugs : TCA compounds, MAOIS, pheothiazine derivatives; b) Antineoplastic drugs: Alkylating agents, Antimetabolites, Plant products; c) Sedatives & Hypnotic agents: Benzodiazepines, Barbiturates; d) Antihistaminics: H1 and H2 antagonists; e) NSAODS: Indomethacin, Ibuprofen, Naproxen and Probenecid, f) Antipyretic Analgesics: Phenacetin, Phenylbutazone, Mefenamic Acid.; g) Cardiovascular Drugs: Hydralazine, Propranolol, Procainamide, Prenylamine. h) Local Anaesthetics :Benzocaine, Procaine, Lignocaine.i) Antimalarials: Chloroquine, Pamaquine, Trimethoprim, j)Diuretics: Chlorothiazide, Acetazolamide, Triamterene; k)Non-steroidal Oestrogens: Stilbesterol, Hexestrol, Dienestrol.

Recommended books:

- | | |
|------------------------|---|
| 1. Wilson and Gisvolds | : Textbook of Organic, Medicinal and Pharmaceutical Chemistry |
| 2. Ashutosh Kar | : Medicinal Chemistry |
| 3. Graham L. Patrick | : An Introduction to Medicinal Chemistry |
| 4. Alfred Burger | : Medicinal Chemistry Vol. I & II |
| 5. E J Ariens | : Drug Designs Vol. I, II & III |
| 6. O P Agarwal | : Chemistry of Organic Natural Products Vol. I & II |
| 7. W O Foye | : Principles of Medicinal Chemistry |
| 8. Wilson and Gisvold | : A Textbook of Medicinal Chemistry |
| 9. Alfred Burger: | : Medicinal Chemistry |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3105

Course Title: Pharmaceutical Technology-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Know about compounding and dispensing of drugs.
- Study on Solution and elixirs, theory of solution, preservation and stability aspects and quality control systems of liquids.
- Learn about the theoretical aspects of suspension and emulsion.
- Obtain knowledge about semisolid dosage forms such as ointments, paste, gels, etc
- Gather knowledge about suppositories and drug decomposition.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- Weigh, measures, calculation for compounding and dispensing, fundamental operation in compounding, current good pharmaceutical practices in compounding and dispensing.
- formulate and evaluate different types of liquid dosage forms such as solutions, elixirs.
- formulate, modify and evaluate all the dispersed dosage forms such as suspension, emulsion, ointments, paste, gels etc.
- classify and formulate of suppositories.
- Prevent drug decomposition and increase drug stability.

Course details:

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 dispensed medications.

2. 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.

3. Dispersed system

- a) Properties of dispersed systems: Theoretical aspects of suspension, emulsion, inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial

- tension, flocculation and coalescence.
- b) Suspension: Definition and application, advantage and disadvantages, aggregated and dispersed system, formulation, manufacturing and stability, evaluation, rheological consideration, illustrative examples.
 - c) 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.
4. **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.
 5. **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.
 6. **Drug decomposition:** Decomposition of drugs and pharmaceutical product, stabilization of pharmaceutical products.

Recommended books:

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

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)	Year: 3 rd (Third)	Semester: 1 st (First)																																	
Course Code: PHARM-3107	Course Title: Pharmaceutical Engineering-I																																		
Course Credit: 2.00	Full Marks: 100																																		
Course Objectives: The objective of the course is to - ➤ develop student’s knowledge on drying, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content etc. ➤ build up knowledge on factors affecting milling operation, mechanisms of size reduction process. ➤ develop knowledge about filtration, filter media, filter aids, filter thickeners, different filtration equipment.																																			
Intended Learning Outcomes (ILOs): At the end of this course the students will be able to ➤ use the appropriate drying process and equipment for maintaining the moisture content of drugs. ➤ apply size reducing process of coarse particles by using different types of mills, particle size distribution and its applications in dosage form design. ➤ perform the purification and separation process by using filtration technique, filter aids.																																			
Course details: 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: construction, operation, merits, demerits of static, moving, fluidized, pneumatic bed systems; different drying equipments tray dryer, spray dryer and freeze dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection. 2. Milling: Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process; principle, design, operation, advantages, disadvantages and 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; and selection of a mill. 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: principle, construction, operation, merits and demerits of gravity nutsche, delpark industrial filter, plate and frame press, vertical pressure leaf filter, horizontal plate filter, vacu-flow suction leaf filter, clarifying filters; selection of filtration equipment.																																			
Recommended books: <table><tr><td>1.</td><td>Cooper & Gunn</td><td>: Dispensing for pharmaceutical students</td></tr><tr><td>2.</td><td>Sprowl</td><td>: American Pharmacy</td></tr><tr><td>3.</td><td>Remington’s</td><td>: Pharmaceutical Sciences</td></tr><tr><td>4.</td><td>Husa & Martin</td><td>: Dispensing of medication</td></tr><tr><td>5.</td><td>Aulton</td><td>: Pharmaceutical Practice</td></tr><tr><td>6.</td><td>Fishburn</td><td>: An introduction to Pharmaceutical Formulations</td></tr><tr><td>7.</td><td>Polderman</td><td>: An introduction to Pharmaceutical productions</td></tr><tr><td>8.</td><td>Martindale</td><td>: The extra Pharmacopoeia</td></tr><tr><td>9.</td><td>Bentey’s</td><td>: Textbook of Pharmaceutics</td></tr><tr><td>10.</td><td>Cooper & Gunn</td><td>: Tutorial Pharmacy</td></tr><tr><td>11.</td><td>Lachman</td><td>: Theory and Practice of Industrial Pharmacy</td></tr></table>			1.	Cooper & Gunn	: Dispensing for pharmaceutical students	2.	Sprowl	: American Pharmacy	3.	Remington’s	: Pharmaceutical Sciences	4.	Husa & Martin	: Dispensing of medication	5.	Aulton	: Pharmaceutical Practice	6.	Fishburn	: An introduction to Pharmaceutical Formulations	7.	Polderman	: An introduction to Pharmaceutical productions	8.	Martindale	: The extra Pharmacopoeia	9.	Bentey’s	: Textbook of Pharmaceutics	10.	Cooper & Gunn	: Tutorial Pharmacy	11.	Lachman	: Theory and Practice of Industrial Pharmacy
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10.	Cooper & Gunn	: Tutorial Pharmacy																																	
11.	Lachman	: Theory and Practice of Industrial Pharmacy																																	
* Other books will be indicated by respective teachers																																			

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3111

Course Title: Pharmacology- III

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objectives of the course are to -

- know about signaling mechanisms and drug action.
- provide knowledge about introduction and uses of the cardiovascular drugs.
- learn about various pathway of drug metabolism, metabolism of various group of drugs.
- gather knowledge about diabetes, different types of diabetes and antidiabetic drugs.
- give information about local and general anesthetics.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- familiar with regulation of gene expression by intracellular receptors, Ligand regulated transmembrane enzymes, legand gated channels, G-proteins and secondary messengers, such as cyclic-AMP.
- demonstrate the mechanism of action, therapeutic uses, adverse effects, interactions, and contraindications of cardiac drugs.
- discuss about role of drug metabolism in human body.
- know about causes of diabetes and effect of antidiabetic drugs.
- learn about how local and general anesthetics work in our body.

Course details:

1. Molecular Mechanism of Drug Action: Signaling mechanisms and drug action: Regulation of gene expression by intracellular receptors, Ligand regulated transmembrane enzymes, legand gated channels, G-proteins and secondary messengers, such as cyclic-AMP, calcium and phosphoinositides and cyclic-GMP interplay among signaling mechanisms.

2. Cardiovascular Drugs:

- a) Functioning and diseases of the heart, arrhythmia, ischemia, angina pectoris, coronary thrombosis, myocardial infarction, arteriosclerosis, atherosclerosis, hypertension and congestive heart failure.
- b) 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) α -Blockers, Prazosin, etc. (ii) β -Blockers, Propanolol, etc. (iii) M.A.O. inhibitors, Methyldopa, Rauwolfia alkaloids. (iv) Ca-channel blocking agents. (v) Vasodilators: Nitrites

and nitrates.

- c) Diuretics: Cardiac anhydrase inhibitors, low and high ceiling diuretics, potassium sparing diuretics and osmotic diuretics.
 - d) Antiarrhythmic drugs: Quinidine, Procaine amide.
- 3. 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.
- 4. Antidiabetic Drugs:** **a)** Introduction and classification of diabetes. **b)** Hyperglycemia and hypoglycemia. **c)** Introduction, classification, chemistry, mode of action, structure activity relationship, pharmacokinetics, indications, contraindications, 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.
- 5. Anesthetics:** Introduction and classification.
- a) Local anesthetics: general properties, chemistry and SAR, mechanism of action, pharmacological action, clinical use and fate of cocaine, procaine, benzocaine, lignocaine, lidocaine, etc.
 - b) General anesthetics. (i) Inhalation anesthetics: Halothene, enflurane, methoxyflurane, nitrous oxide, diethyl ether, cyclopropane and ethylene, etc. (ii) Intravenous anesthetics: Barbiturates, opioids, etc.

Recommended books:

- | | |
|--|--|
| 1. Goodman & Gillman | : Pharmacological Basis of Therapy |
| 2. H P Rang, M. M. Dale and J. M. Ritter | : Pharmacology |
| 3. A Gilman, T W Rall, A S Nies | : The Pharmacological Basis of Therapeutics |
| 4. R S Satoskar and S D Bhandarkar | : Pharmacology and Pharmacotherapeutics Vol. I & II |
| 5. A. Goldstein, L Aronow and S M Kalman | : Principles of Drug Action, The Basis of Pharmacology |
| 6. B G Katzung | : Basic and Clinical Pharmacology |
| 7. F H Meyers, E Jawelz and A Goldfien | : Review of Medical Pharmacology |
| 8. Meyer | : Medical Pharmacology |
| 9. Goth | : Medical Pharmacology |
| 10. R. S. Satosker | : Pharmacology and Pharmcotherapeutics |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3104

Course Title: Medicinal Chemistry- II Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objectives of the course are to -

- develop student's knowledge to synthesis of organic compounds .
- learn about drug design.
- extract metabolic enzymes from liver and determine drug receptor interaction.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- develop their ability to exploit organic reactions to synthesize organic molecules.
- design drugs through computer aided drug design.
- determine how metabolic enzymes are extracted from liver.

Course details:

1. Synthesis of organic compounds of medicinal importance
2. Studies of drug design
3. Extraction of metabolic enzymes from liver and their effects
4. Exercises on drug receptor interactions

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3106

Course Title: Pharmaceutical Technology-I Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objectives of the course are to -

- check physical properties of emulsions, suspensions, syrups, ointments, suppositories etc.
- Develop basic practical concepts on formulation of liquid pharmaceutical dosage forms.
- determine what problems are encountered during preparation of drugs.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- compare the physical properties of emulsions, suspensions, syrups, ointments, suppositories etc.
- learn preparation and filling of different suspensions, emulsion, syrup, pastes.
- solve the problems during the preparation of drugs.

Course details:

1. Physical checking of emulsions, suspensions, syrups, ointments, suppositories etc.
2. Formulation of emulsions, suspensions, syrups, ointments, suppositories etc.
3. Preparations, problems encountered during preparation, physical evaluation of the different dosage forms: (a) Tablets including coated tablets (b) Capsules (c) Suppositories (d) Pharmaceutical aerosols

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 1st (First)

Course Code: PHARM-3112

Course Title: Pharmacology-II Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objectives of the course are to -

- estimate the concentration of salicylic acid in blood after oral administration of aspirin tablet.
- estimate paracetamol concentration in blood after administration.
- know about local anesthetics and anti-histamine.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- know how salicylic acid works and its pharmacological effect.
- learn the mechanism of action of paracetamol, its indication, side effects, contraindications etc.
- gain knowledge about different types of local anesthetics and antihistaminic drugs.

Course details:

1. Estimation of salicylic acid in blood after administration of aspirin tablet
2. Estimation of paracetamol in blood after administration
3. Test of local anesthesia
4. Estimation of anti-histamine in blood after administration
5. Industrial Tour in a Pharmaceutical plant (one day)

Program Name: B. Pharm (Hons.)

Year: 3rd (Second)

Semester: 1st (First)

Course Code: PHARM-3110

Course Title: Oral examination

Course Credit: 1.00

Full Marks: 100

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3201

Course Title: Bio-Pharmaceutics-I

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Provide basic concept about biopharmaceutics, pharmaceutics, pharmacokinetics and pharmacodynamics etc.
- Learn about gastrointestinal absorption and distribution of drugs.
- inform about Theoretical aspects of drug elimination, excretion and biotransformation.
- gather knowledge on bioavailability and bioequivalence.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- share their knowledge on physicochemical properties of drugs , dimension of biopharmaceutics, apparent volume of distribution and its significance; bioavailability, its determination and significance; Area Under Curve (AUC),
- discuss about biological and physicochemical consideration of drugs, drug distribution, drug-protein interaction.
- explain glomerular filtration, active tubular secretion, tubular re-absorption, determination of renal clearance, biotransformation of Drugs.
- point out different parameters relative to bioavailability, methods of assaying bioavailability, drug product selection on the basis of bioavailability testing.

Course details:

1. **Introduction to pharmaceutics and Biopharmaceutics:**

Biopharmaceutics, pharmacokinetics and pharmacodynamics, physicochemical properties, dimension of biopharmaceutics, apparent volume of distribution, its determination and significance; bioavailability, its determination and significance; Area Under Curve (AUC), its determination and significance; plasma drug concentration, plasma half life and their determination, significance; kinetics of oral/ IM drug administration.

2. **Gastrointestinal absorption and distribution of drugs:**

Biological Consideration: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.

Physicochemical Consideration: pKa and gastrointestinal absorption, pH-partition theory and other physicochemical factors. Dosage form consideration: Role of different dosage form like solution, suspension tablet, capsule, emulsion etc. on gastrointestinal absorption. Disintegration and dissolution of drugs.

Distribution of drugs: Important Pharmacokinetic Parameters: Biological half-life, apparent volume

of distribution, area under the curve, absorption and elimination rate constant etc. Interpretation of drug-plasma level curve.

Drug-Protein Interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of binding sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.

3. **Drug clearance:**

a) Theoretical aspects of drug elimination, excretion and biotransformation.

Renal Elimination: Glomerular filtration, active tubular secretion, tubular re-absorption. Determination of renal clearance, *Biotransformation of Drugs:* Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michaelis-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), Biliary excretion of drug.

4. **Bioavailability and Bioequivalence:**

Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies. Drug product selection on the basis of bioavailability testing.

Recommended books:

- | | |
|------------------------------------|---|
| 1. Leon Shargel and Andrew B.C. Yu | : Applied Biopharmaceutics and Pharmacokinetics |
| 2. M. Gibaldi | : Biopharmaceutics & Clinical Pharmacokinetics |
| 3. Notari | : Biopharmaceutics & Clinical Pharmacokinetics |
| 4. T.G. Wagner | : Biopharmaceutics & Relevant Pharmacokinetics |
| 4. Donald E. Cadwallader | : Biopharmaceutics & Drug Interactions |
| 5. M. Gibaldi and D. Perrier | : Pharmacokinetics |
| 7. Bourne, Triggs and Eadie | : Pharmacokinetics for the Non-mathematical |
| 8. CVS Subrahmanyam | : Textbook of Physical Pharmaceutics |
| 9. Shargel | : Biopharmaceutics. |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3203

Course Title: Quality Assurance & Validation

Course Credit: 2.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Introduce about quality control, quality assurance and validation.
- Learn in process quality assurance method.
- Know about validation and its importance.
- Provide information on management of quality assurance and analytical methodology.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- Explain the importance of pharmaceutical analysis in the quality control of drugs.
- Describe the concept of quality assurance, methods of drug sampling, statistical quality control of major categories of dosage forms, QA activities,
- Learn the necessities of validation.
- Know about total quality management, accreditation criterion of CRM providers, International Standard Organization (ISO) and World Trade Organization (WTO).

Course details:

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 laboratory for pharmaceutical analysis, personnel, equipment, environments, etc. Types of specifications, testing program and methods.
2. **In Process quality assurance method:** Concept of quality assurance, selection and testing of major raw materials input. Methods of drug sampling, statistical quality control of major categories of dosage forms, QA activities, Basic concept of cGMP, ISO-9000, ISO-9001, TQM, SOP. Quality control of raw materials, packaging materials, bulk product, finish product, weighing control, IPC. Quality review and documentation, process and quality validation of equipments validation, regulatory control, regulatory drug analysis and interpretation of analytical data.
3. **Validation concept and its importance:** Validating process and equipment, advantages of validation.
4. **Management of quality assurance:** Quality management consideration, quality motivation, total quality management. ISO/IEC 17025: 2005, CRM, SRM, RM, IRM, EUPh Standard, USP Standard, CRM providers, Accreditation criterion of CRM providers. International Standard

Organization (ISO) and World Trade Organization (WTO), International Accreditation Bodies, Bangladesh Accreditation Board (BAB), NABL, Accredited Laboratories in Bangladesh. Policy, Organizational structure and Service Providing Process of Bangladesh Standard Testing Institute (BSTI), Drug Administration (DA) and Bangladesh Pharmacy Council (BPC)

5. Quality of analytical methodologies, automated continuous system for assay procedure, associated activities. FDA

Recommended books:

1. M. Shah Nawaz Khan : Assurance of Quality Pharmaceuticals
2. Pulok K. Mukherjee : Quality control of herbal drugs

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3205

Course Title: Pharmaceutical Technology-II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn about formulation & manufacturing of tablets, tablet coating, common tableting problems and evaluation of tablets, compaction and compression of powder.
- Build up knowledge about hard gelatin and soft gelatin capsules.
- Acquire knowledge on Micro-encapsulation Technology.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- to formulate and evaluate different types of solid dosage forms such as tablet, capsules and find out different stages of tablet compression, common tableting problems and different methods of tablet coating.
- To differentiate between hard gelatin and soft gelatin capsules and its advantages and disadvantages.
- identify methods of preparation of micro-encapsule and pharmaceutical and biological applications of micro-encapsulation process

Course details:

1. Tablet dosages form:

- Formulation & 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.
- 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.
- 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.
- 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.

2. Capsule dosage forms:

- a) **Hard gelatin capsules:** Definition and classification, advantages and limitations of capsule dosage form, gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories. Problems in capsule manufacturing, quality control methods of capsules, packaging of capsules.
- b) **Soft gelatin capsules:** Definitions and classifications, advantages and limitations, properties, formulation, manufacturing, quality control and packaging of soft capsules. Problems and remedy of soft capsule manufacturing.

3. Micro-encapsulation Technology: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of micro-encapsulation process.

Recommended books:

- | | |
|---|---|
| 1. L. Lachman, H.A. Lieberman, J.L. Kanig | : The Theory and Practice of Industrial Pharmacy |
| 2. E. A. Rawlins | : Bentley's Textbook of Pharmaceutics |
| 3. S. J. Carter (Ed.) | : Cooper and Gunn's Dispensing for
Pharmaceutical Students |
| 4. M. E. Aulton | : Pharmaceutics, the Science of Dosage Form Design |
| 5. L. V. Allen, N. G. Popovich
And H. C. Ansel | : Pharmaceutical Dosage Forms and
Drug Delivery Systems |
| 6. A. R. Gennaro | : Remington, The Science and Practice of Pharmacy |
| 7. L.W. Dittert | : Sprowl's American Pharmacy |
| 8. A.G. Fishburn | : An introduction of Pharmaceutical Formulations |
| 9. K. E. Avis, H. A. Lieberman,
and L. Lachman, (eds.) | : Pharmaceutical Dosage Forms: Parenteral
Medications, Vol. I & II |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3207

Course Title: Pharmaceutical Engineering-II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Acquire knowledge about centrifugation.
- Gain information on mixing technology such as solid-solid mixing, liquid mixing, paste mixing.
- Develop student's knowledge about air conditioning, refrigeration and humidity control.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- Discuss about principle, operation, merits and demerits of different centrifuge machines.
- know the importance of mixing in pharmaceutical industry.
- choose required air conditioning equipments, measurement of humidity, equipments for humidification operation, select appropriate compressors and its usages as well as maintenance.

Course details:

1. **Centrifugation:** General principles, magnitude of centrifugal force, materials of construction, principle, operation, merits and demerits of different centrifuge machines; critical speed, sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.
2. **Mixing Technology:**
 - 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) 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.
 - c) 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.

3. 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.
- b) Refrigeration: Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage, pharmaceutical application of refrigerator.
- c) Humidity control: Terminologies such as psychometry, absolute humidity, relative humidity, dew point, humid heat, humid volume, wet bulb temperature and adiabatic saturation temperature etc, relationship between wet bulb and adiabatic saturation temperatures, humidifier, dehumidifier, uses of psychometric charts, measurement of humidity and applications of humidity control.

Recommended books:

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

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3211

Course Title: Pharmacology-IV

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Know the basic knowledge of hormones.
- Gain details information about enzymes.
- Gather knowledge about anticancer drugs.
- Apply the pharmacological knowledge in diseases treatment.
- Detail study of water and fat soluble vitamins.
- Study on ophthalmology.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- Demonstrate the biochemistry and mode of action of hormones.
- Assess the general properties of enzymes and their mode of actions, activators, inhibitors and cofactors.
- Know about mechanism of action of anticancer drugs and its side effects, toxicity, contraindication etc.
- to solve the problems raised due to toxicological effects of antitubercular drugs, antibiotics and antifertility drugs.
- Differentiate between water and fat soluble vitamins its effect in human health.
- Learn about different types of ophthalmic products and its use, side effect etc.

Course details:

1. **Hormones:** Biochemistry and mode of action of hormones. Hormones as drugs.
2. **Enzymes in Therapy:** General properties of enzymes and their mode of actions, activators, inhibitors and cofactors, enzymatic basis of drug action. Enzymes of pharmaceutical importance, their production, preparation, formation, use and assay methods.
3. **Anticancer Agents:** (a) Alkylating agents: Nitrogen mustard, alkyl sulphonates and nitrosoureas. (b) Anti-metabolites: (i) Folic acid analog (ii) Pyrimidine analog (iii) Purine analog and related inhibitors. (c) Natural products: (i) Vinca alkaloids (ii) Antibiotics (iii) Miscellaneous agents (metal complexes, radioisotopes, hormones, etc.)

4. Pharmacological Studies of Various Groups of Drugs:

- i) Drugs used in the treatment of tuberculosis: (a) Chemotherapeutics: INH, para-aminosalicylic acid, ethambutol, pyrazinamide, etc. (b) Antibiotics: gentamicin, rifampicin, streptomycin, etc.
- ii) Antidiarrhoeal agents: ORS, tetracycline, streptomycin, sulfonamide, loperamide and spasmodic drugs, etc.
- iii) Anti-fertility drugs: Oral contraceptives, mechanical barriers, implants, foams, etc.
- iv) Drugs used in Acquired Immune Deficiency Syndrome (AIDS)

5. Vitamins: Detailed study of water and fat soluble vitamins.

6. Ophthalmology: Anatomical consideration, corneal grafting, cataract formation, contact lens, drugs used in the treatment of eye disorders.

Recommended books:

- | | |
|----------------------|---|
| 1. Goodman & Gillman | : Pharmacological Basis of Therapeutics |
| 2. Katzung | : Medical Pharmacology |
| 3. Meryer | : Medical Pharmacology |
| 4. A Goth | : Medical Pharmacology |
| 5. R.S. Satosker | : Pharmacology & Pharmacotherapeutics |

*** Other books will be indicated by respective teachers**

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3202

Course Title: Bio-pharmaceutics- I Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- learn about in-vivo study of bioavailability of drug.
- develop knowledge about in-vitro study of bioavailability of drug.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- determine the concentration of aspirin in urine and the concentration of paracetamol in blood after oral administration.
- calculate disintegration and dissolution time of solid dosage forms and determine the viscosity of a prepared emulsion.

Course details:

1. In vivo study of bioavailability of drug: (a) Determination of concentration of aspirin in urine after oral administration (b) Determination of paracetamol in blood after oral administration.
2. In vitro study of bioavailability of drug: (a) Disintegration and dissolution tests of solid dosage forms (b). Determination of viscosity of a prepared emulsion.

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3206

Course Title: Pharmaceutical Technology-II Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- Gather knowledge about tablet, capsule and micro-encapsules.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- apply their knowledge to small scale laboratory production of solid dosage forms and physical evaluation of different dosage forms.

Course details:

Preparation, problems encountered during preparation, physical evaluation of different dosage forms;

1. Tablet
2. Capsule
3. Micro-encapsules

Program Name: B. Pharm (Hons.)

Year: 3rd (Third)

Semester: 2nd (Second)

Course Code: PHARM-3212

Course Title: Pharmacology-III Lab

Course Credit : 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05 %
Lab attendance	10%
Lab note book on experiment	05 %
Viva-voce on experiment during practical exam	10 %
Semester end final examination	70 %

[The examination of this practical course shall be of 6 (Six) hours duration]

Course Objectives: The objective of the course is to -

- learn about different types of cardiac drugs on toad's heart.
- know the effect of CNS drugs on toad.
- study the effect of acetylcholine on toad heart and muscle.
- develop knowledge of chemotherapeutic agents on diseases rats.

Intended Learning Outcomes (ILOs): At the end of this course the students will be able to-

- know how digitalis, adrenaline, noradrenalin, isoprenaline act on toad's heart.
- realize the mechanism of action on CNS drugs on toad and its pharmacological effects.
- Learn how acetylcholine works on toad heart and muscle.
- know how chemotherapeutic agents are used in the treatment of diseases rats.

Course details:

1. Effect of digitalis, adrenaline, noradrenalin, isoprenaline on toad's heart
2. Effect of CNS stimulant, CNS depressants on toad
3. Effect of acetylcholine on toad heart and muscle
4. Effect of chemotherapeutic agents on diseases rats
5. Industrial Tour in a local Pharmaceutical plant (one day)

Program Name: B. Pharm (Hons.)

Year: 3rd (Second)

Semester: 2nd (Second)

Course Code: PHARM-3210

Course Title: Oral examination

Course Credit: 1.00

Full Marks: 100

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 1st (First)

Course Code: PHARM-4101

Course Title: Biopharmaceutics-II

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Acquire knowledge about various body compartments.
- Know the absorption kinetics of drugs.
- Learn dose calculation during repetitive dose administration.
- Know about intravenous dosage forms' kinetics and absorption.
- Calculate dose during various diseases state.
- Gain knowledge of non-compartmental drug analysis.
- Learn about relation of drugs' pharmacokinetics with its therapeutic action.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Analyze drug content in various compartments of body.
- Calculate different absorption rate constants of drugs.
- Compute drug dose incase of multiple drug administration.
- Estimate drug during intravenous therapy.
- Dose tuning for renal diseases.
- Analyze drug pharmacokinetics for non-compartmental model.
- Relate among pharmacokinetics features and drug response.

Course details:

1. **Compartmental Analysis:** Introduction, 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. 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.
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.

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.
4. **Intravenous infusion:** One compartment model drugs, two compartment model drugs, infusion plus loading dose.
5. **Dosage adjustment in renal disease:**
 - a) Pharmacokinetic considerations, general approaches for dose adjustment in renal disease, dose adjustment based on drug clearance, method based on changes in the elimination rate constant, measurement of glomerular filtration rate (GER), calculation of creatinine clearance from serum creatinine concentration. Dose adjustment based on monogram. Giusti Hayton method, Wagner method.
 - b) Extracorporeal removal of drugs, dialysis.
6. Non-compartmental analysis, physiologic-pharmacokinetic model, statistical moment, means residence time etc.
7. Relationship between pharmacokinetic and therapeutic responses.

Recommended books:

- | | |
|------------------------------------|--|
| 1. Milo Gibaldi | : Biopharmaceutics and Clinical Pharmacokinetics |
| 2. Leon Shargel and Andrew B.C. Yu | : Applied Biopharmaceutics and Pharmacokinetics |
| 3. Donald E. Cadwallader | : Biopharmaceutics and Drug Action |
| 4. Bourne, Triggs and Eadie | : Pharmacokinetics for the Non-mathematical |
| 5. CVS Subrahmanyam | : Textbook of Physical Pharmaceutics |

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 1st (First)

Course Code: PHARM-4103

Course Title: Pharmaceutical Technology-III

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Know various aspects of sustained release dosage forms.
- Learn about pharmaceutical aerosols.
- Gain knowledge about clean room design.
- Be on familiar with various aspects of parenterals and ophthalmic products.
- Know about packaging of pharmaceuticals.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Manufacture and evaluate the quality of sustained release drug products.
- Manufacture and evaluate the quality of aerosols.
- Use and monitor clean room for different pharmaceutical products.
- Formulate and quality control of parenterals and ophthalmic products.
- Choose the best package for different pharmaceutical dosage forms based on their nature.

Course details:

1. **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.
2. **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.
3. **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.

4. **Parenteral and Ophthalmic Products:** Definition and classification of parenteral products, 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.
5. **Packaging Technology:** Purpose of packaging, properties of packaging materials, factors influencing choice of package, advantages and disadvantages of different packaging materials, glass and glass containers, metal and metal containers, plastic and plastic containers, films foils and laminates, rubber based materials, closures, tamper resistant packaging, testing and quality assurance of packaging materials, different packaging machines and accessories, organization of packaging line and sealing.

Recommended books:

1. L Lachman,HA Lieberman,JL Kanig : The Theory and Practice of Industrial Pharmacy
2. E. A. Rawlins : Bentley's Textbook of Pharmaceutics
3. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design
4. A. R. Gennaro : Remington, The Science and Practice of Pharmacy
5. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students
6. H. C. Ansel and N. G. Popovich : Pharmaceutical Dosage Forms and Drug Delivery Systems

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 1st (First)

Course Code: PHARM-4105 **Course Title:** Molecular Biology and Bioinformatics

Course Credit: 3.00 **Full Marks:** 100

Course Objectives: The objective of the course is to -

- Gain primary knowledge of molecular biology.
- Know the structure, functions and properties of nucleic acid.
- Know the structure, functions and properties of protein.
- Study about transcription, translation and replication.
- Learn about various techniques that are frequently employed in molecular biology.
- Analyze human genome, identify targets for drug discovery, study structural and functional relationship, and molecular evolution.
- Provide an outline of the different approaches to sequence alignment.
- List the concepts and applications of sequence searching for protein, provide examples of basic sequence alignment, introducing concepts of point mutations, deletions, insertions etc.
- Apply the process to do and evaluate a phylogenetic analysis and explain the different steps.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to learn-

- Basic concept of cell and their components.
- Physicochemical properties of nucleic acids and their biological significance.
- Physicochemical properties of protein their biological significance.
- Theoretical knowledge of various process and rule of enzymes involved in DNA and RNA processing.
- Advanced theoretical idea on molecular biology techniques to apply this technique.
- An understanding of the intersection of life and information sciences, the language of structure-function relationship, information theory, gene expression and database queries.
- The metrics used to assess the quality of a pairwise sequence alignment, the differences between homologues, paralogues and orthologues, the pairwise sequence approach to identify mutations.
- Extracting and generating pairwise sequence alignments for a protein sequence of interest.
- Evolutionary process at the molecular level and molecular methods to study genetic variation.

Course details:

1. **Introduction to molecular biology:** Differences between prokaryotic cells and eukaryotic cells, structure and functions of mitochondria and chloroplasts, cytoskeleton, cell development and differentiation. Mendelian law, Chromosomal theory of heredity, Chromosomal determination of sex, Chromosomal mapping of Annotment, Mendelian second law, preliminary attempts to find a gene protein relationship.
2. **Nucleic Acid:** Structure, isolation, purification and molecular weight determination, chemical and enzymatic hydrolysis and hybridization.

3. **Proteins:** Structures of proteins, important domains and their functions, conformational changes of protein, denaturation and renaturation of protein, synthesis of protein, protein sequencing.
4. **Central dogma of molecular biology:**
 - a) Replication: DNA replication, DNA polymerases, types of DNA replication, and inhibitors of replication.
 - b) Transcription: RNA synthesis and mRNA processing (post-translational modification of mRNA, promoters, enhancers and transcriptional factor) in bacteria and yeast, inhibitors of transcription.
 - c) Genetic code: Characteristic feature of genetic code, Wobble hypothesis with experimental evidence, initiation and termination codon.
 - d) Translation: Structure of Ribosome, mechanism of translation, (protein synthesis), post-translational modification, inhibitors of translation.
5. **Techniques in molecular biology:** Polymerase chain reaction (PCR), DNA sequencing techniques, Southern, Northern and Western blotting, agarose gel electrophoresis, SDS- PAGE, RT-PCR, In-vitro kinase assay Real time PCR, Reverse Transcriptase.

Bio-informatics

1. **Bioinformatics databases:** Introduction, nucleotide sequence databases, primary nucleotide sequence databases, secondary nucleotide sequence databases, protein sequence databases, sequence motif databases, protein structure databases.
2. **Sequence alignment and database searching:** Single sequence alignments, biological motivation, pairwise alignments, database searching including BLAST, multiple sequence alignments.
3. **Protein structure alignments:** Definition of structure superposition, structure alignment, different alignment algorithms, number of protein folds in PDB.
4. **Phylogenetics:** Sequence-based taxonomy, from multiple alignment to phylogeny, computer tools for phylogenetic analysis.

Recommended books:

- | | |
|---------------------------------------|--------------------------------------|
| 1. De Robertis | : Cell and Molecular Biology |
| 2. Stefan Surzycki | : Human Molecular Biology |
| 3. W.H. Elliott and Daphne C. Elliott | : Biochemistry and Molecular Biology |
| 4. P.C. Turner and M.R.H. White | : Instant Notes in Molecular Biology |
| 5. S.P. Vyas and V.K. Dixit | : Pharmaceutical Biotechnology |
| 6. Harvey Lodish | : Molecular cell Biology |

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 1st (First)

Course Code: PHARM-4107

Course Title: Clinical Pharmacy and Toxicology

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Prepare students with introductory coursework of clinical pharmacy and related sciences.
- Know different aspects of drug uses other than therapeutic uses.
- Study about clinical laboratory analysis.
- Give understanding of various diseases of human.
- Provide knowledge on the preclinical safety and toxicological evaluation of drug & new chemical entity.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Learn about foundational aspects of clinical pharmacy.
- Gain an insight of drugs misuses.
- Interpret clinical conditions and choose suitable medicine.
- Pathophysiological analysis of diseases condition and their management.
- Evaluate various types of toxicity studies and their procedure

Course details:

Clinical Pharmacy:

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.
2. Drug abuse, drug addiction, drug habituation, drug dependence and drawbacks of self-medication.
3. Clinical chemistry & interpretation of clinical laboratory tests
 - a) Blood chemistry
 - b) Hematology
 - c) Urinalysis
4. Clinical interpretation of pathophysiology of the following diseases
 - a) Diabetes
 - b) Essential hypertension,
 - c) Anaemia
 - d) AIDS
 - e) Tuberculosis

- f) Peptic ulcer and
- g) Venereal diseases: UTI, RTI, etc.

5. Toxicology:

- (a) 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.
- (b) Drugs adverse effects:** Principles, evaluation in animals, determination of LD₁₀, LD₅₀, ED₅₀, therapeutic index, etc. Adverse reactions, causes of adverse reactions, factors affecting side effects of drugs. Drug allergy, tests for prediction of drug allergy.

Recommended books:

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

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 1st (First)

Course Code: PHARM-4109 **Course Title:** Pharmaceutical Marketing

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Provide students with the basis of marketing, selling and communication in the pharmaceutical market.
- Give tactical knowledge of fruitful marketing.
- Educate how communicate effectively with consumer in different situations; interpret the nonverbal clues of a communication partner.
- Teach concerning fragmented and targeted marketing policy.
- Train about basics and major methods of advertising and promotion.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Explain basics of marketing; recall different methods of selling and mention steps of the selling process.
- Differentiate between effective and in ineffective communication for product selling.
- Pick the most suitable approach to convince people with different personality styles.
- Recognize application of specific marketing in competitive pharma world.
- Select efficient promotional media for any product.

Course details:

1. **Principles of marketing:** Definition and concepts of marketing, steps in the marketing process, role of marketing & environmental forces in our society, marketing mix and exchange relationships, marketing management process, the selling concept, marketing concept and the societal concept, customer relationship management, demarketing.
2. **Strategic marketing planning:** Strategic planning process, resources and opportunities affecting the planning process, corporate, business-unit, and marketing strategies, the marketing plan and implementation process and the major approaches to marketing implementation.
3. **Consumer markets and buying behavior:** Consumer market & business market, elements of a consumer behavior model & organizational buyer behavior, consumer buying process, factors affecting consumer behavior, types of buyer behavior, buying decision process, consumer decision process for new products or adoption process.

4. **Market segmentation, target marketing and marketing positioning strategies:** Identifying market segment, factors for segmenting market, choosing a target marketing strategy, market positioning for maximum competitive advantages.
5. **Product promotion:** Elements in the communication process, promotions mix (advertising, personal selling, sales promotion, public relation, direct marketing)and their roles in Integrated Marketing Communication (IMC), the promotions message and executions style, media choice, promotional objectives, representatives, physical distribution, inventory and cost control, returns and claims.

Recommended books:

1. Handfield R Robert : Introduction to Supply Chain Management
2. Philip B Schary : Managing the Global Supply Chain
3. Douglas M Lambert : Strategic Physical Distribution Management
4. Bowersox : Physical Distribution
5. H R Tesdal : Introduction to Sales Management
6. Hisrich, Robert D : Entrepreneurship Development

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 1st (First)

Course Code: PHARM-4102 **Course Title:** Bio-Pharmaceutics-II Lab

Course Credit: 1.00 **Full Marks:** 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this practical course shall be of 6 (six) hours duration]

Course Objectives: The objective of the course is to –

- Use differential equations for simple pharmacokinetic models.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Calculate the absolute and relative bioavailability of a drug, given either plasma concentration or urinary excretion data following different dosage forms or routes of administration

Course details:

Evaluation of drugs and drug products pharmacokinetics.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 1st (First)

Course Code: PHARM-4104 **Course Title:** Pharmaceutical Technology- III Lab

Course Credit: 1.00 **Full Marks:** 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this practical course shall be of 6 (six) hours duration]

Course Objectives: The objective of the course is to -

- Make students practically skilled in pharmaceutical formulations and their quality evaluation.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Prepare and assay different sterile and parenteral products.

Course details:

Preparation of water for injection, preparation of injection of (a) procaine and adrenaline, (b) procaine benzylpenicillin. Studies of formulation and problems on ophthalmic preparations and sustained releases products.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 1st (First)

Course Code: PHARM-4106

Course Title: Molecular Biology and Bioinformatics Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this practical course shall be of 6 (six) hours duration]

Course Objectives: The objective of the course is to -

- Endow with practical knowledge of molecular biology techniques.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Execute various fundamental tasks that are frequently employed in molecular biology.

Course details:

Agarose-gel electrophoresis of nucleic acid; SDS –PAGE, Isolation of plasmid DNA, Estimation of DNA, RNA and oligonucleotides.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 1st (First)

Course Code: PHARM-4112

Course Title: Clinical Pharmacy/ Hospital Training
/Industrial Training/Pharmaceutical Industry In-Plant
training

Course Credit: 3.00

Full Marks: 100

Marks Distribution:

Report of the Industrial Tour/Filed work/In-plant Training	50%
Overall performance in the Tour/Field work/Training	30%
Viva-voce/Quiz/Presentation	20%

Course Objectives: The objective of the course is to -

- Give practical knowledge of pharmacy profession.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Understand and perform all activities of graduate pharmacists.

Course Details:

At the end of the 3rd year 2nd semester the students will experience in-plant training program for several weeks in pharmaceutical industry. After successful completion of the training program the students will have to submit a dissertation to the department.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 1st (First)
Course Code: PHARM-4110 **Course Title:** Oral examination
Course Credit: 1.00 **Full Marks:** 100

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4201 **Course Title:** Cosmetology

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Learn about general structure and function of skin and various glands.
- Give knowledge of various skin care creams.
- Provide theoretical idea of different types of shaving products.
- Furnish the knowledge of dental preparations.
- Gain knowledge about hair products like shampoo, conditioners etc.
- Learn about various beautifying preparations.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Realize basic physiology of skin.
- Learn manufacturing process, problems, remedies, quality control, and evaluation of different skin preparations.
- Learn manufacturing process, problems, remedies, quality control, and evaluation of shaving creams.
- Learn manufacturing process, problems, remedies, quality control, and evaluation of dental products.
- Learn manufacturing process, problems, remedies, quality control, and evaluation of various hair products.
- Understand different kinds of cosmetic preparations such as deodorant, lip products.

Course details:

1. **Cosmetology:** The skin: Introduction, epidermis and keratinizing system, pigmentary system, langerhans cell, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin.
2. **Skin creams:** Introduction, classification of skin creams, cold cream, vanishing creams, emollient cream and lotion.
3. **Shaving preparations:** Introduction, lather shaving cream, brushes less or non-lathering cream, aerosol shaving foams, after shave preparations.

4. **Dental products:** Introduction, formulation and manufacture of toothpastes, tooth powder and mouthwash.
5. **Hair products:** Introduction, shampoos, hair setting lotions, hair tonic and conditioners etc.
6. Brief study on deodorant (Talcum powder, perfume), lip-products etc.

Recommended books:

1. M S balsam : Cosmetics Science and Technology (Vol. 1 & II)
2. S. N Sahn : Preparation and Distribution of Drugs & Cosmetics

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)
Course Code: PHARM-4203 **Course Title:** Biotechnology and Genetic Engineering
Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Provide basic understanding of principles, techniques and application of biotechnology in drug and drug related products.
- Explain the principles that form the basis for recombinant DNA technology.
- Learn about DNA and PCR technology.
- Gain knowledge of various types of vaccines.
- Understand the students with monoclonal antibody technique.
- Provide knowledge of catalytic mechanisms of enzyme reactions, with an emphasis on: cofactors in enzymology, mechanisms of group transfer reactions etc.
- Enable students to acquire fundamental knowledge of fermented food production and food analysis in the field of pharmaceutical industry technologies.
- Build an appreciation for how disruption of normal genetic processes can cause developmental problems and disease.
- Learn about biotechnological drugs and related therapeutic products.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Understand the different aspects of biotechnology.
- Use the knowledge of recombinant DNA technology in genetic engineering.
- Apply the principle of DNA and PCR technology in pharmacy.
- Explain the sources of vaccine with their respected uses.
- Explain the concept and application of monoclonal antibody technology.
- Obtain knowledge about various applications of enzymes in the fields of pharmaceutical industry.
- Become familiar with the operation of fermentation machinery in pharma industry.
- Gain interests and abilities in discovering and exploiting novel biotechnology drugs finally to contribute to effective gene therapy.
- Know about biotechnological pharmaceuticals and their quality control tools.

Course details:

1. **Introduction to molecular biotechnology:** Definition, history, dimension and applications.
2. **Recombinant DNA technology (i)** Introduction to genetic engineering **(ii)** Tools of genetic engineering **(iii)** Techniques of genetic engineering **(iv)** Applications of genetic engineering.
3. **Chemical synthesis sequencing and amplification of DNA-PCR (i)** Automated DNA sequencing **(ii)** Polymerase chain reaction (PCR) and gene synthesis by PCR.
4. **Basic Immunology and Immunological Products:** Vaccines – types, source, applications.
5. **Monoclonal antibodies and hybridoma technology (i)** Introduction to Monoclonal antibodies **(ii)** Production of Monoclonal antibodies **(iii)** Applications of Monoclonal antibodies.
6. **Enzyme technology and immobilization (i)** Introduction to Enzyme **(ii)** Production of Enzyme **(iii)** Enzyme immobilization and applications.
7. **Fermentation technology (i)** Introduction to Fermentation technology **(ii)** Improvement of industrial strains of microorganisms **(iii)** Fermentative, medium and inoculums development and **(iv)** Biological products obtained from fermentation.
8. Gene therapy and antisense therapy.
9. **Biotechnology and pharmacy (i)** Drugs obtained from biotechnology **(ii)** Stability, bioavailability and designing drug delivery systems for biotechnological products **(iii)** Biotechnology: a view towards future.

Recommended books:

1. D. A. Crommelin & R D. Sindelar : Pharmaceutical Biotechnology
2. Gary Walsh : Biopharmaceuticals: Biochemistry and Biotechnology
3. Heinrich Klefenz : Industrial Pharmaceutical Biotechnology
4. Lirikjian Su : Biotechnology Theory and Techniques
5. Michael J. Groves : Pharmaceutical Biotechnology
6. O. Kayser and R H Müller : Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications
7. S. P. Vyas : Methods in Biotechnology and Bioengineering
8. S. S. Purohit and A. K. Saluja : Pharmaceutical Biotechnology. Agrobios
9. S. Srivastava : Molecular Biology and Biotechnology
10. William Zito : Pharmaceutical Biotechnology: A Programmed Text

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4205 **Course Title:** Pathology

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Develop students' understanding of medical laboratory science which, encompasses the disciplines of human pathology.
- Teach about cellular phenomena.
- Learn regarding various inflammatory disorders and remedies.
- Know the most common lab findings for the diseases i.e., AIDS, syphilis etc.
- Gather the important information that is needed for the evaluation of nutritional disorders.
- Know about common pathologic conditions seen on the organ system (for example, GI pathology).

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Apply knowledge and skills of laboratory science to accurately perform a variety of laboratory tests/analytical techniques.
- Demonstrate various cellular abnormalities and their remedies.
- Explain the role and relevance of treatment in inflammatory diseases.
- Know laboratory manifestations of infectious diseases and how to interpret laboratory information.
- Understanding and interpretation of nutritional diseases.
- Demonstrate professional responsibility in organ related diseases management.

Course details:

- 1. Introduction to pathology:** Definition, history, dimension and its application in pharmacy.
- 2. Cellular Injury and Adaptation:** Morphology of injured cells, intracellular accumulation, sub-cellular alteration, adaptation, neuralgia.
- 3. Inflammation and Repair:** Morphological patterns and changes in vascular flow and permeability, phagocytosis, chemical mediators, mechanisms of regeneration and repairing, gastritis, ulceration, pleuritis, cervicitis.

4. **Hemodynamic De-arrangement:** Edema, hyperemia, congestion, thrombosis, embolism, infarction, shock etc.
5. **Infectious Diseases:** Infectious agents, Mechanism of infection, Routes of microbial entry, Infectious diseases such as Herpes simplex, AIDS, diphtheria, whooping cough, tuberculosis, syphilis, plague, tetanus, giardiasis, trichomoniasis, pneumonia, filariasis.
6. **Nutritional disease:** Nutritional disease, dietary insufficiencies, protein energy malnutrition such as Marasmus, kwashiorkor, cachexia, and deficiency states of minerals and vitamins such as Vitamin A, D, C; Obesity and its consequences.
7. **Disorder of organ system and their management:** Gastrointestinal disorders: peptic ulcer disease, inflammatory bowel disease, constipation and diarrhea; Hepatic disorders: Adverse effect of drugs on liver, liver diseases; Renal disorders: Acute renal failure, Chronic renal failure; Cardiovascular disorder: hypertension, CHD, CHF, arrhythmias, thrombosis, dyslipidaemia; Respiratory disorders: Asthma, chronic obstructive pulmonary diseases, drug induced lung diseases.

Recommended books:

1. J. Winfield : Pharmaceutical Practice. 3rd Edition
2. Joseph T Dipiro *et. al.* : Pharmacotherapy: A Pathophysiological Approach
3. Robbins and Cotran : Atlas of Pathology
4. Robbins and Cotran : Review of Pathology
5. Russell J. Greene, Norman D. Harris : Pathology and Therapeutics for Pharmacists
6. Martin M. Zdanowicz : Essentials of Pathophysiology for Pharmacy
7. R Walker and Clive Edwards : Clinical Pharmacy and Therapeutics. 3rd edition
8. Randy Hendrickson : Remington: the Science and Practice of Pharmacy
9. S. Lakhani, S. A. Dilly, & C. J. Finlayson : Basic Pathology: An Introduction to the Mechanisms of Disease
10. Vinay Kumar, Nelso Fausto : Pathologic Basis of Disease

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4207 **Course Title:** Drug Regulatory Affairs

Course Credit: 2.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Know the various dimensions of drug abuse.
- Describe the governmental organization and process within the pharmacy profession.
- Explain Bangladeshi legislation and regulations for pharmacy and their impacts on pharma sector.
- Gain the understanding of professional ethics.
- Learn the guidelines of *International conference on Harmonization*.
- Provide the knowledge of international drug regulatory body.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Aware about drug abuse and their remedies.
- Demonstrate information applicable to regulatory affairs submissions and management systems.
- Explain the various acts, rules and regulations and their implementation in drug sale, production, import etc.
- Understand the code of ethics of pharmacy profession and their execution in real life.
- Describe international harmonization of regulations and impact on drug manufacturing and their uses.
- Comprehend the role of international drug control agency on pharmaceutical sector.

Course details:

- 1. Drug abuse:** Definition, Bangladesh and international status, Problem associated with drug abuse, Cases and remedy in drug abuse.
- 2. Pharmaceutical Regulatory Organizations:** Introduction, Pharmacy council of Bangladesh (PCB), Directorate General of Drug Administration (DGDA), Their scope and Activities, Approval process, format and registration of pharmaceuticals in Bangladesh.
- 3. Pharmaceutical Regulatory Affairs -The Drugs Acts, Rules, Ordinance and Policies:** The Drugs Acts, Rules, Ordinances and policies concerning to the manufacture, possession,

distribution, sale of drugs and poisons, The Pharmacy ordinance 1976. The Drug Policy 1982, Essential Drug List, The Drug act 1940, The Drug (control) ordinance 1982, The narcotics (Control) act 19990, The Poisons Act 1919 and related amendments, The Bangladesh Unani and Ayurvedic Practitioners Ordinance,1983.Control of Drug Advertisements and prices, patented and trademarked medicine, proprietary medicine, schedules of drugs and poisons, regulation of cosmetics and poison control.

4. ***The code of ethics in pharmacy profession:*** Introduction, Law and ethics committee, Content of ethics, Code of ethics in pharmaceutical Marketing Practice (**CPMP**) in Bangladesh content of **CPMP**.
5. ***International conference on Harmonization (ICH) of Technical Requirements for Registration of Pharmaceuticals for Human Use:*** Introduction, Initiation of ICH, The evolution of ICH, Classification of ICH guidelines.
6. ***Foreign Drug Regulatory Agencies:*** Introduction, USFDA, TGA Of Australia, MHRA of UK, Health Canada, Some other important Drug Regulatory Agencies (Indian,Chienese, Pakistan, Brazil, South African), Gulf cooperation council drug regulatory authority(GCC).

Recommended books:

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
3. Drug Policy of Bangladesh, Ministry of Health and Population Control, Health Division, Dhaka
4. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh
5. B M Mithal : A Textbook of Forensic Pharmacy
6. A. R. Gennaro : Remington's Pharmaceutical Sciences
7. Md.Shah Amran : Pharmaceutical Regulatory Affairs and Standards

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4209 **Course Title:** Pharmaceutical Management

Course Credit: 3.00 **Full Marks:** 100

Marks Distribution:

Class attendance	10 %
Quiz/presentation	05%
In-course/tutorial /assignment	15 %
Semester end final examination	70 %

[The examination of this theoretical course shall be of 4 (Four) hours duration and students have to answer 5 questions out of 8 and each question will carry 14 marks]

Course Objectives: The objective of the course is to -

- Know the fundamentals of management, planning and knowing the structure.
- Learn types of business unit formats that comprise the various pharmaceutical practices and their implications for business practice.
- Understand the basics of manpower management.
- Give knowledge about various inventory control system, their comparative advantages and disadvantages.
- Give the detail idea about proper management of materials inside and outside pharmaceutical industry.
- Know the role of pharmacists in production planning and production control.
- Understand the duties and responsibilities of pharmacists in various subdivision of pharmacy and health system.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Describe the nature and role of management in the pharmaceutical sector.
- Compare among various business organizations and choose the best one.
- Manage the human resources of a company from the emotional and laborer point of view, developing clear objectives and the professional career.
- Know how to control the management of purchases, sales, stock and analyze the profit margins of a product.
- Achieve the necessary skills to effectively manage materials regarding materials procurement, storing and timely supply in different units.
- Develop the competencies necessary to manage smooth production.
- Realize the role of the pharmacists in pharmaceutical and health care sector.

Course details:

1. **Nature and Principles of Management:** Style of management, the MBO system and improving decision-making.

2. **Organization Structures:** Social organization and legal organization, the sole proprietorship, the general partnership, private and public limited companies, their relative advantages and disadvantages.
3. **Personnel Management:** Definition, scope, importance, behavioral science and personnel management. (a) Motivation, moral and job satisfaction. (a) Education, training, management development and performance evaluation. (b) Means of achieving harmonious industrial relation collective bargaining, joint consultation worker council, arbitration, and industrial democracy.
4. **Inventory Control:** Methods-intuitive, systematic want book, perpetual inventory, open-to-buy, stock, record card, economic order quantity, selection of optimum methods, effect of inventory control.
5. **Materials Management:** Purchasing: Formulating effective buying policies, determination of needs and desires of patrons, selecting the sources of supply, determination the terms of purchase, receiving, marketing and stocking goods.
6. **Production Management:** Definition, scope, importance and application of management, techniques and principles to production management, production planning and quality control.
7. **Managerial Role of Pharmacists:** Pharmacists in different services of health and pharmaceutical industry, marketing & sales, regulatory affair research & development, hospital pharmacy, community pharmacy etc.

Recommended books:

- | | |
|-----------------------------------|---|
| 1. R. M. Mehta | : Pharmaceutical Industrial Management |
| 2. Kotler Armstrong | : Principles of Marketing |
| 3. V.S. Ramaswamy | : Marketing Management |
| 4. F.D. Sturdivant and L.W. Stern | : Managerial Analysis in Marketing |
| 5. Robert E. Stevens | : Strategic Marketing Plan Master Guide |
| 6. H.A. Smith | : Principles and Methods of Pharmacy Management |
| 7. Leon Lachman | : Theory and practice of industrial pharmacy |

* Other books will be indicated by respective teachers

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4202 **Course Title:** Cosmetology Lab

Course Credit: 1.00 **Full Marks:** 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this practical course shall be of 6 (six) hours duration]

Course Objectives: The objective of the course is to -

- Demonstrate preparation of various cosmetic preparations.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Carry out formulation and quality evaluation of cosmetic products.

Course details:

Preparation of different types of cosmetic products such as skin products (cold cream and vanishing cream), shaving preparations (lather shaving cream and after shave preparation), hair products (shampoos) and their stability testing.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth)

Semester: 2nd (Second)

Course Code: PHARM-4204

Course Title: Biotechnology and Genetic Engineering Lab

Course Credit: 1.00

Full Marks: 100

Marks Distribution:

Laboratory performance during lab hours	05%
Lab attendance	10%
Lab note book on experiment	05%
Semester end final examination	70%
Viva-voce during practical exam	10%

[The examination of this practical course shall be of 6 (six) hours duration]

Course Objectives: The objective of the course is to –

- Learn the various methods to assess drug resistance and to measure bimolecular concentration.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Use the disk diffusion method and Lowry method.

Course details:

Determination of bacterial drug resistance by disk diffusion method, Estimation of protein concentration by Lowry method.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)

Course Code: PHARM-4212 **Course Title:** Project/Internship Dissertation/ Presentation and Report

Course Credit: 4.00 **Full Marks:** 100

Marks Distribution:

Presentation of the Project/ Internship	50 %
Dissertation of the Project/ Internship work	30%
Overall Performance during the work	20%

Course Objectives: The objective of the course is to -

- Introduce students with research activities.

Intended Learning Outcomes (ILOs): At the end of this section the students will be able to-

- Conduct independent research work, data analysis and presentation of research work.

Course details:

Project titles will be provided by the supervisor of the student. The supervisor will be in overall charge of the management of the project and will also ensure that the student adheres to the project regulations and requirements. The students will carry out project work involving literature survey, an experimental investigation, and final preparation of thesis on a selected topic. At the end of the project each student will submit a dissertation and give an oral presentation of his or her findings.

Program Name: B. Pharm (Hons.) **Year:** 4th (Fourth) **Semester:** 2nd (Second)
Course Code: PHARM-4210 **Course Title:** Oral examination
Course Credit: 1.00 **Full Marks:** 100