

Introduction

The University launched the educational activities of the Department of Pharmacy from January 2006 under the Faculty of Science. The new department is well equipped with its laboratories and library facilities.

Pharmacy is the branch of medical science that embraces a thorough study of all the aspects of drugs including their discovery, synthesis, formulation, manufacturing, quality assurance, storage, distribution, dispensing, counseling and so on. So it is evident that the health care management cannot achieve its desired goal without adequate contribution to pharmacy in profession. Appreciating this vital role of pharmacy profession the University introduced the Bachelor of Pharmacy (Hons.) Programme under the Faculty of Science.

Aims & Objectives

The aim of the Bachelor of Pharmacy (Hons.) Programme is to build up professional experts on drugs to meet the demands of the age in the field of pharmacy. The principal objectives set to reach this aim are:

1. To impart scientific knowledge for the identification, formulation, preparation, standardization, quality control and uses of drugs and medicines and effective management of their distribution & sale.
2. To produce skilled manpower to manage the affairs of hospital pharmacies, pharmaceutical industries, community pharmacy services, drug quality control organizations, drug research, marketing, sales & administration.
3. To encourage research on indigenous medicinal plants and traditional medicine, and development of drugs from them.

Courses & Curriculum

Pharmacy education provides the background to understand completely all there is to understand about drugs. The courses taught under the Bachelor of Pharmacy (Hons.) Programme can be divided into two groups:

- i) Core courses and
- ii) Supplementary courses.

The core courses of the curriculum of the following subjects:

1. **Pharmaceutical Chemistry** including physical pharmacy, chemistry of both inorganic and organic pharmaceuticals, synthetic and natural medicinal products, pharmaceutical synthesis, API synthesis, analysis and quality control of pharmaceutical products, stability studies etc.
2. **Pharmaceutics** including pharmaceutical technology, industrial pharmacy, pharmaceutical microbiology, hospital pharmacy, dispensing, management, pharmacy laws and administration, physical pharmacy and bio-pharmaceutics.
3. **Pharmacology** including pharmacology, clinical pharmacology, clinical biochemistry, community pharmacy and toxicology.
4. **Pharmacognosy** including various aspects of natural crude drugs and other economic products of pharmaceutical importance, traditional medicine, **ethnopharmacology** and forensic pharmacognosy.
5. **Physiology** which forms the basis of the pharmacology course.

The principal supplementary subjects that constitute essential aspects of the pharmacy curriculum include the following subjects:

1. **Biochemistry** which prepares the students for understanding of the advanced pharmacology courses like biochemical pharmacology, bio-pharmaceutics, drug metabolism etc.
2. **Statistics** which is required for statistical analysis and interpretation of biological studies and experimental results.
3. **Computer Science** which is required for presenting the analytical data, results of experimental and biological studies.
4. **English Fundamental** which is required for improved written and vocal skill in English.

Teaching Methodology

The Bachelor of Pharmacy (Hons.) programme is a four-year degree programme. The whole duration of the course is divided into 8 (eight) semesters and the students will have to appear in the semester final examination at the end of the each semester. The teaching methodology comprises extensive theoretical and practical classes, in-class assessment, viva voce etc.

Medium of Instruction

Since English is the major language of communication in the scientific and technological world, the medium of instruction is English. Students are required to have proficiency in spoken and written English. However in the 1st Semester students are taught one course on English to make them skilled in Technical and Communicative English.

Admission Process

The students must pass HSC, A-level or recognized equivalents with the following science subjects: Physics, Chemistry, Biology and Mathematics. A student must secure at least three B grades in the above mentioned subjects to qualify for admission.

Admission should be based on competitive written test evaluations. In addition to written test, oral test may be taken for further assessment.

Course Curriculum

The entire undergraduate program is covered by a set of theoretical and practical (laboratory/field) courses, all together 160 credits in 8 different semesters.

- a) Theoretical Courses: A minimum of 45 and 25 contact hours per session will constitute for 3 and 1.5 credit courses respectively.
- b) Practical Courses: Each Practical (Laboratory/field) course will be counted as one credit.
- c) All students have to complete 160 credits for graduation.

The B Pharm (Hons.) programme shall be an integrated one consisting of core and Supplementary courses, carrying a total of 160 credits as distributed below

(semester-wise).

Year	Semester	Theoretical	Viva-voce	Practical	Project &/ Training	Total Credits
1 st	1 st	15	-	2	-	17
	2 nd	15	1	4	-	20
2 nd	3 rd	13.5	-	4	-	17.5
	4 th	15	1	4	-	20
3 rd	5 th	16.5	-	4	-	20.5
	6 th	15	1	4	-	20
4 th	7 th	16.5	-	3	-	19.5
	8 th	18	1	2	4.5	25.5
Total		124.5	4	27	4.5	160

Hours of Study

Theoretical courses: A minimum of 45 and 25 contact hours per session will constitute 3 and 1.5 credit course, respectively.

Practical courses: A minimum of 30 hours practical classes will constitute 1 credit course.

Project

The students are required to undertake a research project in the 4th year in various field of pharmaceutical Science as assigned by the respective supervisor. Research project will be distributed in the 4th year 1st semester.

Internship

After completion of the 8th Semester final Examination every student shall be required to undergo a practical training programme for at least 200 hours in a pharmaceutical industry or a hospital or a dispensary as may be arranged by the authority.

Registration

Successful candidate, after passing B Pharm (Hons.) Final Examination will be eligible for submitting application to the Pharmacy Council of Bangladesh for Registration Examination and only the successful candidates will get registration certificate.

Examination Policy

Examinations should be base on written, oral and practical assessments. The Head of the Department, or the Course Director / Coordinator, with approval of the Head of the Department, has the potion to re-examine any student at any time or to give the student any additional test or tests other than those regularly scheduled, with the objective of arriving a t a more accurate evaluation of the students, academic performance.

Examination materials will be retained by the Controller of Examinations / Course Director / Coordinator / Head of the Department until registration for the next academic session and unless grade appeal has been filed. Materials should be retained as long as an appeal is in progress.

Distribution of Marks

Attendance	05 %
Behaviour	05 %
Midterm Examination	20 %
Class Performance	10 %
Assignment	10 %
Final Term Examination	50 %
Total	100 %

The Term Final Examination Must includes the total syllabus of the course.

1. There should be an examination committee to execute all activities related to the examinations.
2. Question moderation should be done in presence of an external member from any public university.
3. There should be an oral assessment system at the end of every year. The assessment should be done in the presence of a public university teacher, as an external examiner.

The Grading System

The Letter Grade:

The total performance of a student in a given course is based on a scheme of continuous assessment. For theory courses this continuous assessment is made through Attendance, Behaviour, Midterm Examination, Class Performance, Assignment and semester Final Examination. The assessment in laboratory courses is made by evaluating performance of the student at word during the class, viva-voce during laboratory hours. Each course has a certain number of credits, which describes its corresponding weight ages. A letter grade with a specified number of grade points is awarded in each course for which a student is registered. A student's performance is measured by the number of credits completed satisfactorily and by the weighted average of the grade points earned, A minimum grade point average (GPA) is essential for satisfactory progress. Total 160 credits have to be acquired in order to qualify for the degree. Letter grades and corresponding grade points will be awarded in accordance to the provisions shown below:

Grade	Grade Points	Numerical Markings.
A+	4.0	80 % and above
A	3.75	75 % to below 80 %
A-	3.50	70 % to below 75 %
B+	3.25	65 % to below 70 %
B	3.00	60 % to below 65 %
B-	2.75	55 % to below 60 %
C+	2.50	50 % to below 55 %
C	2.25	45 % to below 50 %
D	2.00	40 % to below 45 %
F	0.00	Below 40%
X	-	Continuation (For project/thesis)

"Subject in which the student gets 'F' grades will not be counted towards credit hours requirements and for the calculation of Grade Point Average (GPA)

The semester-wise subject of studies and Marks Distribution

The courses taught under the Bachelor of Pharmacy (Hons.) programme over the 04 academic years in 08 semesters are outlined below:

First Year First Semester		
PHARM-101	Inorganic Pharmacy-I	Credit Hr: 3
PHARM-102	Inorganic Pharmacy-I-Lab	Credit Hr: 1
PHARM-103	Physical Pharmacy-I	Credit Hr: 3
PHARM-104	Physical Pharmacy-I-Lab	Credit Hr: 1
MAT-101	Mathematics & Statistics	Credit Hr: 3
CS-101	Computer Science	Credit Hr: 3
HUM-101	Introductory English	Credit Hr: 3
	Total Credit Hours	17

First Year Second Semester		
PHARM-111	Inorganic Pharmacy-II	Credit Hr: 3
PHARM-112	Inorganic Pharmacy-II-Lab	Credit Hr: 1
PHARM-113	Organic Pharmacy-I	Credit Hr: 3
PHARM-114	Organic Pharmacy-I-Lab	Credit Hr: 1
PHARM-115	Physical Pharmacy-II	Credit Hr: 3
PHARM-116	Physical Pharmacy-II-Lab	Credit Hr: 1
PHARM-117	Pharmacognosy-I	Credit Hr: 3
PHARM-118	Pharmacognosy-I-Lab	Credit Hr: 1
HUM-111	Bangladesh Studies	Credit Hr: 3
VV-111	Viva-voce	Credit Hr: 1
	Total Credit Hours	20

Second Year First Semester		
PHARM-201	Organic Pharmacy-II	Credit Hr: 3
PHARM-202	Organic Pharmacy-II-Lab	Credit Hr: 1
PHARM-203	Pharmacognosy-II	Credit Hr: 3
PHARM-204	Pharmacognosy-II-Lab	Credit Hr: 1
PHARM-205	Basic Anatomy	Credit Hr: 1.5
PHARM-206	Physiology-I	Credit Hr: 3
PHARM-207	Physiology-I-Lab	Credit Hr: 1
PHARM-208	Pharmaceutical Microbiology-I	Credit Hr: 3
PHARM-209	Pharmaceutical Microbiology-I-Lab	Credit Hr: 3
	Total Credit Hours	17.5

Second Year Second Semester		
PHARM-211	Physiology-II	Credit Hr: 3
PHARM-212	Physiology-II-Lab	Credit Hr: 1
PHARM-213	Pharmaceutical Microbiology-II	Credit Hr: 3
PHARM-214	Pharmaceutical Technology-I	Credit Hr: 3
PHARM-215	Pharmaceutical Technology-I-Lab	Credit Hr: 1
PHARM-216	Pharmacology-I	Credit Hr: 3
PHARM-217	Pharmacology-I-Lab	Credit Hr: 1
PHARM-218	Biochemistry & Cellular Biology	Credit Hr: 3
PHARM-219	Biochemistry & Cellular Biology-Lab	Credit Hr: 1
VV-411	Viva-Voce	Credit Hr: 1
	Total Credit Hours	20

Third Year First Semester		
PHARM-301	Pharmaceutical Analysis-I	Credit Hr: 3
PHARM-302	Pharmaceutical Analysis-I-Lab	Credit Hr: 1
PHARM-303	Pharmaceutical Technology-II	Credit Hr: 3
PHARM-304	Pharmaceutical Technology-II-Lab	Credit Hr: 1
PHARM-305	Pharmacology-II	Credit Hr: 3
PHARM-306	Pharmacology-II-Lab	Credit Hr: 1
PHARM-307	Medicinal Chemistry-I	Credit Hr: 3
PHARM-308	Medicinal Chemistry-I-Lab	Credit Hr: 1
PHARM-309	Pathology	Credit Hr: 3
PHARM-310	Nutraceuticals, Dietary Supplements and Herbal Products	Credit Hr: 1.5
	Total Credit Hours	20.5

Third Year Second Semester		
PHARM-311	Pharmaceutical Analysis-II	Credit Hr: 3
PHARM-312	Pharmaceutical Analysis-II-Lab	Credit Hr: 1
PHARM-313	Pharmaceutical Technology-III	Credit Hr: 3
PHARM-314	Pharmaceutical Technology-III-Lab	Credit Hr: 1
PHARM-315	Pharmacology-III	Credit Hr: 3
PHARM-316	Pharmacology-III-Lab	Credit Hr: 1
PHARM-317	Medicinal Chemistry-II	Credit Hr: 3
PHARM-318	Medicinal Chemistry-II-Lab	Credit Hr: 1
PHARM-319	Hospital & Community Pharmacy	Credit Hr: 3
W-311	Viva-voce	Credit Hr: 1
	Total Credit Hours	20

Fourth Year First Semester		
PHARM-401	Pharmaceutical Analysis-IV	Credit Hr: 3
PHARM-402	Pharmaceutical Analysis-IV-Lab	Credit Hr: 1
PHARM-403	Medicinal Chemistry-III	Credit Hr: 1.5
PHARM-404	Cosmetology	Credit Hr: 3
PHARM-405	Cosmetology-Lab	Credit Hr: 1
PHARM-406	Biopharmaceutics and Pharmacokinetics-I	Credit Hr: 3
PHARM-407	Biopharmaceutics and Pharmacokinetics-I Lab	Credit Hr: 1
PHARM-408	Pharmaceutical Engineering	Credit Hr: 3
PHARM-409	Clinical Pharmacy	Credit Hr: 3
	Total Credit Hours	19.5

Fourth Year Second Semester		
PHARM-411	Pharmaceutical Biotechnology	Credit Hr: 3
PHARM-412	Advanced Pharmacology and Toxicology	Credit Hr: 3
PHARM-413	Biopharmaceutics-II	Credit Hr: 3
PHARM-414	Biopharmaceutics-II-Lab	Credit Hr: 1
PHARM-415	Pharmaceutical Quality Control and Analytical Method Validation	Credit Hr: 3
PHARM-416	Pharmaceutical Quality Control and Analytical Method Validation - Lab	Credit Hr: 1
PHARM-417	Pharmaceutical Marketing & Management	Credit Hr: 3
PHARM-418	Pharmaceutical Regulatory Affairs	Credit Hr: 3
PHARM-419	Project	Credit Hr: 3
PHARM-420	In-Plant Training	Credit Hr: 1.5
VV-411	Viva-Voce	Credit Hr: 1
	Total Credit Hours	25.5

First Year First Semester

Curriculum Structure

PHARM-101	Inorganic Pharmacy-I	Credit Hr: 3
PHARM-102	Inorganic Pharmacy-I -Lab	Credit Hr: 1
PHARM-103	Physical Pharmacy-I	Credit Hr: 3
PHARM-104	Physical Pharmacy-I-Lab	Credit Hr: 1
MAT-101	Mathematics & Statistics	Credit Hr: 3
CS-101	Computer Science	Credit Hr: 3
HUM-101	Introductory English	Credit Hr: 3
Total Credit Hours		17

Course Profile:**Course Title: Inorganic Pharmacy-I****Course No: PHARM-101****Credit Hour: 3 Contact Hours: 3****Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Structure of atoms. An elementary treatment of theories of atomic structure, quantum numbers, Pauli's exclusion principle, origin of spectral lines.		
	Chemical bonds.		
	Classification of elements.		
	Chemistry of alkali and alkaline earth metal.		
	Chemistry of co-ordination compounds.		
	Inert and noble gases.		

1. Structure of atoms:

2. Chemical bonds: Electronic concept of valency, different types of chemical bond e.g. ionic, covalent, co-ordinate covalent, metallic, dipole, hydrogen bond etc., theories of covalent bonding and hybridization.

3. Classification of elements: Modern periodic table and periodic law, variation of properties within periods and groups, usefulness and limitations of periodic table.

4. Chemistry of alkali and alkaline earth metals: General characteristics of alkali and alkaline earth metals, chemistry of group IA & II elements and their compounds, comparison of alkaline earth metals with alkali metals, physiological importance and pharmaceutical applications of alkali and alkaline earth metals. '

5. Chemistry of co-ordination compounds: Ligands or co-ordinating groups, monodentate or unidentate ligands, polydentate ligands, co-ordination number, co-ordination sphere, chelation, factors affecting the stability of metal complexes, application of chelate formation, isomerism of co-ordination compounds, Warner's co-ordination theory, Sidgwick's electronic concept of co-ordinate bond in co-ordination compounds, valence bond theory, pharmaceutical importance of chelation.

6. Inert or noble gases: Source, electronic configuration and inertness, isolation of inert gases from dry air (chemical method) and liquid air (physical method), physical & chemical properties and uses noble gases, conditions and types of compounds formed by inert gases.

Course Profile:

Course Title: Inorganic Pharmacy-I Lab

Course No: PHARM-102

Credit Hour: 1 Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Qualitative analysis of inorganic ions and radicals: Na ⁺ , K ⁺ , Ca ⁺ Al ⁺³ , Mg ⁺² , Fe ⁺² , Mn ⁺² , Ag ⁺ , Cu ⁺ , Cu ⁺² , Cl ⁻ , Br, I ⁻ and, CO ₃ ⁻² , SO ₄ ⁻² , NO ₃ ⁻ , PO ₄ ⁻³ etc.		

Books Recommended:

1. Introduction to Modern Inorganic Chemistry- S. Z. Haider, Friends International.
2. Modern Inorganic Chemistry- Madan, S. Chand & Company Ltd.
3. Introduction to Modern Inorganic Chemistry- J. D Lee, Blackwells.
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry- Bently, Arthur Owen, Oxford University Press.
5. Modern Inorganic Pharmaceutical Chemistry- Clarence A. Discher, Leonard C. Bailey, Thomas Medwick, Waveland Pr Inc.
6. Rogers Inorganic Pharmaceutical Chemistry- Rogers, Charles Herbert, Taito O. Some and Charles O. Wilson, Philadelphia, Lea & Febiger.
7. Inorganic Medicinal & Pharmaceutical Chemistry- Block, John H., Roche, Edward B., Some, Taito O., Wilson, Charles O. Lea and Febiger, Philadelphia.

Course Profile:**Course Title:** Physical Pharmacy-I**Course No:** PHARM-103**Credit Hour:** 3 **Contact Hours:** 3**Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Properties of gases.		
	Chemical equilibrium.		
	Chemical thermodynamics.		
	Phase equilibrium.		
	Solution.		
	Solution of electrolytes.		
	Ionic equilibrium.		
	Buffer and isotonic solution.		

1. Properties of gases: Gas laws, ideal gas equation, Dalton's law of partial pressure, diffusion of gases. Kinetic theory of gases, mean free path, deviation from ideal gas behavior, Van der Waals equation. Critical constants, liquefaction of gases, determination of molecular weights, law of corresponding states and heat capacity

2. Chemical equilibrium: Law of mass action, determination of equilibrium constant, heterogeneous equilibrium and homogeneous equilibrium, the Le Chatelier principle, Van't Hoff equation.

3. Chemical thermodynamics: Introduction, the first law of thermodynamics, work, energy and heat, work of expansion, internal energy, determination of internal energy, heat change at constant volume and constant pressure, thermodynamic reversibility, work of isothermal reversible expansion of gases, the maximum work under the isothermal expansion of a gas, heat capacities, difference between molar heats, Adiabatic processes, Joule-Thomson experiment.

Thermochemistry and thermochemical law: Second law of thermodynamics, Carnot's cycle and efficiency of a perfect engine, the concept of entropy and entropy changes for an ideal gas expansion, entropy changes of materials under various conditions, free energy and work functions, Gibbs Helmholtz equation, free energy changes under equilibrium, the Clausius-Clapeyron equation.

4. Phase equilibria: Phase, components and degree of freedom, the phase rules and its thermodynamic deviation, the phase diagrams of water and sulphur systems partially miscible liquid pairs: the phenol and water, nicotine water system; Completely miscible liquid pairs and their separation by fractional distillation; freeze drying (lyophilization).

5. Solution: Types and properties of solution; units of concentration; ideal and real solution; Henry's law; distribution of solids between two immiscible liquids; distribution law; partition coefficient; solvent extraction.

6. Solution of electrolytes: Concentration expressions, equivalent weights, colligative properties of dilute solution, osmotic pressure, measurement of osmotic pressure, Van't Hoff and Morse equations for osmotic pressure, coefficients for expressing colligative properties.

7. Ionic equilibria: Modern theories of acids, bases and salts, acid-base Equilibria, Sorensen's pH scale, Species concentration as a function of pH, calculation of pH, acidity constants,

8. Buffer and isotonic solution : Buffer equations, buffer capacity, buffer in pharmaceutical and biologic systems, buffered isotonic solutions, methods of adjusting tonicity and pH.

Course Profile:

Course Title: Physical Pharmacy-I Lab

Course No: PHARM-104

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Standardization of acids and bases.		
	2. Determination of pKa and pKb values.		
	3. Preparation of solution of different pH & buffer capacity.		
	4. Determination of phase diagram of binary systems.		
	5. Determination of distribution coefficients.		
	6. Determination of mol. Wt. By Victor Meyer's Method.		
	7. Determination of heat of solution by measuring solubility as a function of temperature.		

Books Recommended:

1. Principle of Physical Chemistry- M. Mahbubul Haque & M. Ali Nawab, Student Publication,
2. Martin's Physical Pharmacy and Pharmaceutical Sciences- Patrick J. Sinko, Lippincott Williams & Wilkins.
3. Glasstone Samuel and Lewis David, Elements of Physical Chemistry, Macmillan
4. Physical Chemistry- P. W. Atkins, Peter Atkins, Julio De Paula, W. H Freeman & Company.
5. Essentials of Physical Chemistry- B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Company Ltd.
6. Quantitative analysis- V. Alexeyev, CBS Publishers.
7. Physicochemical Principles of Pharmacy- A. T. Florence and D. Attwood, Macmillan.

Course Profile:

Course Title: Mathematics & Statistics

Course No: MAT-101 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Section A : Mathematics		
	Graphs and gradients.		
	Calculus.		
	Matrices.		
	Section B : Statistics		
	Graphical and diagrammatic representation.		
	Measurement of central tendency.		
	Measures of dispersion.		
	Moments, Skewness and kurtosis.		
	Probability distribution.		

Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	The basic idea of significance test.		
	The correlation of measurement.		
	Regression analysis.		
	Simple experimental design and the analysis of variances.		
	Introduction to factorial experiments.		
	Random samples and random numbers.		

MAT-101

Mathematics & Statistics

Credit Hr: 3

Section A: Mathematics

1. Graphs and gradients: (a) Rectangular co-ordinates, curve fitting using first degree equation in both variables, determination of slope, intercept and points of intersection, equation of 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 and e.

2. Calculus: (a) Rate of process, rules of differentiation, successive and partial differentiation, differentiation of a function of a function relation between the derivatives of inverse function, (b) Rules of integration- integration as a summation, area under a curve, integration by partial fraction, graphical integration.

3. Matrices: Addition, subtraction and multiplication of matrices, unit matrix, row transformation, determinants, inverse of a matrix, solution of equation by matrix.

Section B: Statistics

1. Graphical and diagrammatic representation- Graphs and diagrams.

2. Measurement of central tendency - Arithmetic mean, geometric mean, harmonic mean, median and mode.

3. Measures of dispersion - Range of mean deviation, variance, coefficient of variance, standard deviation.

4. Moments, Skewness and kurtosis.

5. Probability distribution - The normal, binomial and Poisson distribution, derivation, means and variances.

6. The basic ideas of significance test - Simple significance tests based on the normal distribution, comparison with a known standard, comparison of means of two large samples.

The use of 't' test for small samples, importance of small sample comparison of sample mean with a standard, comparison of means of two small sample (unknown variances- assumed equal, not assumed equal) confidence limits.

χ^2 -tests of goodness of fit and homogeneity introduction to general idea, testing the fit of a whole frequency distribution to data, tests of homogeneity, variance ratio test.

7. The correlation of measurement - General notion of correlation, calculation of correlation coefficient.

8. Regression analysis - Basic idea of regression, calculation of regression coefficient, standard error and significance test. Partial correlation and multiple regression with two and more than two independent variables.

9. Simple experimental design and the analysis of variances - Introduction, completely randomized design, randomized block design, testing the homogeneity of variances.

10. Introduction to factorial experiments - Principle basic ideas, notation in 2^n factorial, scope of more advanced designs.

11. Random samples and random numbers- the need and use, representative samples.

Books Recommended:

1. Medical & Pharmaceutical Statistics- Hannan, JMA
2. Pharmaceutical Statistics- Sanfurol Bolton Charles
3. Differential Calculus: Das and Mukharjee.
4. Integral Calculus: Das and Mukharjee.

Course Profile:

Course Title: Computer Science

Course No: CS-101 **Credit Hour:** 3 **Contact Hours:** 3 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. History and general information.		
	2. Programming languages.		
	3. Software.		
	4. Computer and communication.		

1. History and general information: Historical background of computers and computing, classification and application of computers according to size and function, computer logic and computer architecture- a general review of INPUT/OUTPUT media and devices, functional parts and organization of central processing unit, memory and memory organizations, storage device, general review of micro-processor, number system- binary, hexadecimal etc., hardware, software, batch processing, RAM, ROM etc.

2. Programming languages: Introduction to machine language, interpreter, compiler, assembler language, high level language- BASIC, C, FORTRAN, PASCAL etc., algorithm, flowchart, decision table, basic idea of programming, data file and database.

3. Software: (a) Operating system- Introduction to windows, Mac OS and DOS and its commands (b) Application Software - Introduction to word processing software (MS word etc.), analytical software (SPSS etc.).

4. Computer and communication: Internet working, basic principle, gateway and bridge, Internet protocol (IP), protocol translation and computer network.

Books Recommended:

1. Computer Science: C.S. French.
2. Computer Science: Warford.
3. Computer Science: R. Bradley.

Course Profile:

Course Title: Introductory English

Course No: HUM-101 **Credit Hour:** 3 **Contact Hours:** 3 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	A. Comprehension.		
	B. Technical Writing.		
	C. Grammar.		

A. Comprehension:

Extracts from scientific and non-specific essays may be used for answering comprehension questions with a focus on the following abilities:

1. To develop specific vocabularies and understand their meaning in the text.

2. To understand the meaning of phrases, clauses, sentences, paragraphs and the whole extracts.
3. To grab the ideas and organization of the passages.
4. To learn the uses of the sentence structure of the text.

B. Technical Writing:

The aim of this is to enable students: to express themselves appropriately when dealing with Scientific topics and at the same time to enhance their knowledge of non-scientific English in the form of the projects, reports, theses, paper, paragraph, precis, essays, amplification and dialogue writing.

Letters: Application, requests, inquiries, quotations, complaints, tender to newspaper, advertisements.

C. Grammar:

- a. Nominal and functions
- b. Nominal group: determiners (i) Phrases and headwords (ii) Appositives.
- c. Verbal group (i) Modals Auxiliaries (ii) Finite and non-finite verbs (iii) Verb modifiers-adverbial of time, Adverbial of place, Adverbial of manner, adverbial of duration.
- d. Changing words into different parts of speech.
- e. Completing sentences.
- f. Correction of sentences
- g. Transformation of sentences.
- h. Framing WH questions.
- i. Active & Passive Voice
- j. Translation: English to Bangla and vice versa.

Books Recommended:

1. Raihan Shams & Ms. Hoque Reading and Writing Skills, BOU.
2. Thomas N. Hacking, Leslie. A. Oslen, Technical writing and professional communication.
3. Jordon. R.R. Academic writing course. (London: Collins ELT).
4. Bockever, Keith and Brown, Charles P. Oxford: Oxford University press.
5. Oxford- Advanced Learner's Dictionary.
6. The Cambridge English course 1 & 2 (not available Sessional level in Bangladesh) By Micael Swan and Catherine Walter (Cambridge University press, with cassettes.)

First Year Second Semester

Curriculum Structure

Course No.	Course Title	Credit Hours
PHARM-111	Inorganic Pharmacy-II	3
PHARM-112	Inorganic Pharmacy-II- Lab	1
PHARM-113	Organic Pharmacy-I	3
PHARM-114	Organic Pharmacy-I-Lab	1
PHARM-115	Physical Pharmacy-II	3
PHARM-116	Physical Pharmacy-II-Lab	1
PHARM-117	Pharmacognosy-I	3
PHARM-118	Pharmacognosy-I-Lab	1
HUM-111	Bangladesh Studies	3
VV-111	Viva-Voce	1
	Total Credit Hours	20

Course Profile:

Course Title: Inorganic Pharmacy-II

Course No: PHARM-111 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Essential electrolytes.		
	2. Essential trace elements.		
	3. Hematinic preparations.		
	4. Gastrointestinal agents.		
	5. Dental preparations.		
	6. Topical agents.		
	7. Radioactivity and radiopharmaceutic		

Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	als.		
	8. Environmental Chemistry and environmental sciences.		

1. Essential electrolytes: Intra and extra cellular electrolytes (Na, K, Ca and Cl ions.); Electrolytes in acid base therapy.

2. Essential trace elements: Essential trace elements and their preparations (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.) and application in pharmaceutical sciences.

3. Hematinic preparations: Various types of iron and iron salts.

4. 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.

5. Dental preparations: Dental plaque and antiplaque agents, dental caries, fluorides and other anticaries agents (preparation and application), dentifrices.

6. Topical agents: Classification of topical agents, preparations and applications of different antimicrobial, astringent and protective agents.

7. 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.

8.Environmental Chemistry and environmental sciences:

a) What is environment, causes of environmental pollution, types of pollutants (gases like SO₂, SO₃, CO₂, CO, NO, HCl, NO₂ etc., hydrocarbons, cigarettes, smokes, suspended particulate, pesticides, gasoline and industrial waste, pharmaceutical food additives), deleterious effects of pollutants on life cycle, applications and importance of environmental sciences.

b) Heavy Metal toxicity: Poisoning caused by mercury, arsenic lead, iron and copper, their adverse effects on human life cycle and study of antidotes used in these poisoning cases.

Course Profile:

Course Title: Inorganic Pharmacy-II Lab

Course No: PHARM-112

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Identification of inorganic ions from pharmaceutical formulations: Ca ⁺² , Fe ⁺² , Al ⁺³ , Mg ⁺² , K ⁺ and Na ⁺ ions from supplied preparations.		
	2. Conversion of different water insoluble or sparingly soluble drugs into water-soluble form: a. Na/K-salicylate from salicylic acid. b. Na/K-benzoate from benzoic acid. c. Na/K-citrate from citric acid.		
	3. Preparation of inorganic drugs: Aluminium hydroxide gel		

Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	and Magnesium hydroxide.		
	4. Preparation of haematinics: Ferrous sulfate, Ferrous gluconate and Ferrous fumarate.		

1. Identification of inorganic ions from pharmaceutical formulations: Ca^{+2} , Fe^{+2} , Al^{+3} , Mg^{+2} , K^{+} and Na^{+} ions from supplied preparations.
2. Conversion of different water insoluble or sparingly soluble drugs into water-soluble form:
 - a. Na/K-salicylate from salicylic acid.
 - b. Na/K-benzoate from benzoic acid.
 - c. Na/K-citrate from citric acid.
3. Preparation of inorganic drugs: Aluminium hydroxide gel and Magnesium hydroxide.
4. Preparation of haematinics: Ferrous sulfate, Ferrous gluconate and Ferrous fumarate.

Books Recommended:

1. Introduction to Modern Inorganic Chemistry- S. Z. Haider, Friends International.
2. Modern Inorganic Chemistry- Madan, S. Chand & Company Ltd.
3. Introduction to Modern Inorganic Chemistry- J. D Lee, Blackwells.
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry- Bently, Arthur Owen, Oxford University Press.
5. Modern Inorganic Pharmaceutical Chemistry- Clarence A. Discher, Leonard C. Bailey, Thomas Medwick, Waveland Pr Inc.
6. Rogers Inorganic Pharmaceutical Chemistry- Rogers, Charles Herbert, Taito O. Some and Charles O. Wilson, Philadelphia, Lea & Febiger.
7. Inorganic Medicinal & Pharmaceutical Chemistry- Block, John H., Roche, Edward B., Some, Taito O., Wilson, Charles O. Lea and Febiger, Philadelphia.

Course Profile:

Course Title: Organic Pharmacy-I

Course No: PHARM-113

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction.		
	2. Chemistry of aliphatic compounds		
	a) Alkanes, alkenes and alkynes.		
	b) Alcohols, ethers and epoxides.		
	c) Aldehydes and ketones.		
	d) Carboxylic acids.		
	e) Amines.		
	3. Reaction mechanisms		
	a) Addition reaction.		
	b) Substitution reaction.		
	c) Elimination reaction.		
	d) Rearrangement reaction.		

1. Introduction: History of organic pharmacy and chemistry, classification of organic compounds, systematic naming of organic compounds, electronegativity, polarity of bonds, polarity of molecules, structures and physical properties, intermolecular forces, carbonium ions, carbanion ions, electrophiles, nucleophiles, free radicals, hydrogen bonding, melting point, boiling point, solubility etc.

2. Chemistry of aliphatic compounds

(a) Alkanes, alkenes and alkynes: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications of alkanes, alkenes and alkynes.

(b) Alcohols, ethers and epoxides: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

(c) Aldehydes and ketones: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

(d) Carboxylic acids: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

(e) Amines: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

3. Reaction mechanisms:

- a) Addition reaction: Electrophilic; nucleophilic and free radical; 1,2- and 1,4- addition.
- b) Substitution reaction: Unimolecular (S_NI) and bimolecular (S_N2), stereochemistry of S_NI and S_N2 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 rearrangements).

Course Profile:

Course Title: Organic Pharmacy-I Lab

Course No: PHARM-114

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Identification of functional groups from organic compounds/drugs: (a) -COOH (b) -OH (c) -HN ₂ (d) -NO ₂ (e) -CONH ₂ (f) -COOR (g) -C=O (h) H-C=O (i) -Cl (j) -Br (k) -I (l) -CONHR (m) -CONHR (n) -CONR ₂		

Identification of functional groups from organic compounds/drugs:

(a) -COOH (b) -OH (c) -HN₂ (d) -NO₂ (e) -CONH₂ (f) -COOR (g) -C=O (h) H-C=O (i) -Cl (j) -Br (k) -I (l) -CONHR (m) -CONHR (n) -CONR₂

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Books Recommended:

1. Organic Chemistry- Robert Thornton Morrison and Robert Neilson Boyd, Prentice- Hall of India, Private Limited.
2. A Textbook of Organic Chemistry- Arun Bahl and B. S. Bahl, S. Chand & Company Ltd.
3. Organic Chemistry, vol. I & II- L. Fieser, Long man, London.
4. Organic Chemistry- Louis Felser and Mary Feiser, Asia Publishing House, India.
5. Advanced Organic Chemistry- B. S. Bahl and Arab Bahl, S. Chand & Company Ltd.
6. Introduction to Organic Laboratory Techniques- d Donald L, Pavia, Gary M. Lampman, George S. Kriz, Randall G. Engel, Thomson Brooks Cole.
7. Advanced Organic Chemistry- Reactions, Mechanisms and Structure, Jerry March, John Willey & Sons.
8. A Text Book of Organic Chemistry- Raj K. Barisal, New Age International (P) Limited.

Course Profile:

Course Title: Physical Pharmacy-II

Course No: PHARM-115

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Kinetics.		
	A) Physical degradation of pharmaceutical products.		
	B) Chemical degradation.		
	C) Chemical kinetics.		
	2. Interfacial phenomena.		
	3. Rheology and rheology of dispersed system.		
	4. Colloids.		
	5. Electrochemistry.		
	6. Electrochemical cells.		
	7. Micromeritics.		

1. Kinetics:

A) Physical degradation of pharmaceutical products: Loss of water, **absorption** of water, loss of volatile constituents, polymorphism, color change.

B) Chemical degradation: Hydrolysis, oxidation, isomerization, **polymerization**, decarboxylation, factors affecting chemical degradation etc.

C) Chemical kinetics: Definitions, rates and orders of reactions, methods for determination of orders of reactions, influence of temperature on rate of reactions, theories of reaction rates, decomposition of pharmaceutical products, accelerated test for physical, chemical and photochemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination.

2. Interfacial phenomena: Adsorption and Interface, Freundlich and Langmuir isotherm, SET equation. Electrical properties of interfaces, electrical double layer, Nernst and zeta potential, Gibbs equation, spreading, surface active agents, Emulgents, detergents and antifoaming agents, surfactants and drag activity, surfactants and pharmaceutical products.

3. Rheology and rheology of dispersed system: Newtonian liquids, Non-newtonian materials, yield value, plastic pseudo plastic flow, dilatant and thixotropic flow, viscosity of suspending agents.

4. Colloids: Classification, preparation, electrical and optical properties, sedimentation, Stoke's law, stability of colloidal dispersion, protective colloid, sensitization, dialysis, donnan membrane equilibrium, application and uses of colloidal preparation in pharmacy.

5. Electrochemistry: Electrical units and their interrelation, faradays laws of electrolysis and electrochemical equivalents, electrolytic conduction, equivalent conductance and the related facts, conductometric titrations, transference numbers and their determination.

6. Electrochemical cells: Electrode and cell potentials, energy involved in electrode processes, reference electrodes, **buffer** solutions and measurement of pH; Potentiometric titrations and oxidation-reduction systems, concentration cells.

7. Micromeritics: Importance of particle size determination, different means of expressing particle 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.

Course Profile:**Course Title: Physical Pharmacy-II Lab****Course No: PHARM-116****Credit Hour: 1 Contact Hours: 1****Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Viscosity determinations		
	a) Determination of viscosity of pure liquids such as glycerin, alcohol <i>etc.</i>		
	b) Determination of viscosity of liquid pharmaceutical preparation- syrup, emulsion, suspension <i>etc.</i>		
	c) Study of variation of viscosity of liquid with temperature using Ostwald of Engler's viscometer.		
	2. Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/NaOH.		
	3. Determination of adsorption isotherm of oxalic (or acetic) acid from aqueous solution by charcoal and calculation of the constant in Freundlich's equation.		
	4. Determination of the equilibrium constant of the reaction $KI + I \rightleftharpoons KI_3$.		
	5. Determination of solubility of a sparingly soluble salt in water by conductance measurement.		
	6. Determination of velocity constant for the		

Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	hydrolysis of an ester in the basic medium by conductance measurements.		
	7. Determination of the molecular weight of organic solids.		

1. Viscosity determinations

- a) Determination of viscosity of pure liquids such as glycerin, alcohol *etc.*
- b) Determination of viscosity of liquid pharmaceutical preparation- syrup, emulsion, suspension *etc.*
- c) Study of variation of viscosity of liquid with temperature using Ostwald of Engler's viscometer.
2. Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/NaOH.
3. Determination of adsorption isotherm of oxalic (or acetic) acid from aqueous solution by charcoal and calculation of the constant in Freundlich's equation.
4. Determination of the equilibrium constant of the reaction $KI + I \rightleftharpoons KI_3$.
5. Determination of solubility 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 measurements.
7. Determination of the molecular weight of organic solids.

Books Recommended:

1. Principle of Physical Chemistry- M. Mahbubul Haque & M. Ali Nawab, Student Publication,
2. Martin's Physical Pharmacy and Pharmaceutical Sciences- Patrick J. Sinko, Lippincott Williams & Wilkins.
3. Glasstone Samuel and Lewis David, Elements of Physical Chemistry, Macmillan
4. Physical Chemistry- P. W. Atkins, Peter Atkins, Julio De Paula, W. H Freeman & Company.
5. Essentials of Physical Chemistry- B. S. Bahl, G. D. Tuli and Aran Bahl, S. Chand & Company Ltd.
6. Quantitative analysis- V. Alexeyev, CBS Publishers.
7. Physicochemical Principles of Pharmacy- A. T. Florence and D. Attwood, Macmillan.

Course Profile:

Course Title: Pharmacognosy-I

Course No: PHARM-117

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Definition and scopes of Pharmacognosy.		
	2. Drug literature and publications.		
	3. Structures of the cell as a unit.		
	4. Crude drugs.		
	5. Plant analysis.		
	6. Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important drugs of each group:		
	a) Lipids		
	b) Carbohydrate and related compounds		
	c) Alkaloids		
	7. Plants in complimentary and traditional systems of medicine.		
	8. Vitamins and vitamin containing few selected animal drugs.		
	9. Fibres, Surgical dressings and Sutures.		

- 1. Definition and scopes of Pharmacognosy,** its historical development.
- 2. Drug literature and publications:** Pharmacopoeia, Codex, Formulary, Dispensatory and Index etc. Official, nonofficial and unofficial drugs.
- 3. Structures of the cell as a unit:** Its function and form, introduction to the general structure of the morphological parts of the plants.
- 4. Crude drugs:** A general view of their origin, distribution, cultivation, collection, drying, and storage, commerce and quality control, classification of drugs, preparation of drugs for commercial market, evaluation of crude drugs, drug adulteration.
- 5. Plant analysis:** Extraction, separation, chromatography, types of plant constituents, comparative phytochemistry and chemotaxonomy.
- 6. Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important drugs of each group:**
 - a) Lipids:** Castor oil, Linseed oil, Coconut oil, Olive oil, Peanut oil, Chaulmoogra oil and Beeswax.
 - b) Carbohydrate and related compounds:** Sugars and sugar containing drugs- sucrose, dextrose, liquid glucose, fructose etc. Polysaccharide containing drugs- starches, dextrans etc. Gums and mucilages- tragacanth, acacia, sterculia, sodium alginate, agar, cellulose, derivatives.
 - c) Alkaloids:** Definition, distribution, properties, tests, extraction, structural types and classification.
- 7. Plants in complimentary and traditional systems of medicine:** Introduction, different types of alternative systems of treatments (eg. Ayurvedic, Unani, Homeopathic medicine.), Contribution of traditional drugs to modern medicines, details of some common indigenous traditional drugs: Punarnava, Vashaka, Anantamul, Arjuna, Chirata, Picrorhiza, Kalomegh, Amla, Asoka, Bahera, Haritaki, Tulsi, Neem, Betel nut, Joan, Karela, Shajna, Carrot, Bael, Garlic, Black cumin, Jam and Madar.
- 8. Vitamins and vitamin containing few selected animal drugs:** Cod liver oil, Shark liver oil, Hilsha fish/liver oil etc.
- 9. Fibres, Surgical dressings and Sutures:** Definitions, sources, distribution, characteristics, tests, preparation, uses of different types of fibres, surgical dressings and sutures.

Course Profile:**Course Title: Pharmacognosy-I Lab****Course No: PHARM-118****Credit Hour: 1 Contact Hours: 1****Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. The cell, cell contents and cell types.		
	The cell - (a) some cellular organism, chalk & diatomite. (b) Fungi- Mucor or rhizopus, aspergillus, penicillium, ergot and yeast.		
	Cell contents - Starches and derivatives; calcium carbonate; silica.		
	Cell types - Parenchyma and modifications - colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiate stem, parenchyma-pericyclic fibres jute, xylem fibers and vessels-liquorice, tracheids-pinus wood.		
	2. Epidetamal		

	<p>cells and associated structures (trichomes, stomata etc.), leaves of belladonna, menthn, rosemary, senna, Indian hemp, digitalis etc. Seed trichomes-cotton and nux-vomica seeds; cork ceils-cascara sagrada.</p>		
	<p>3. Study of some groups of unorganized white and off-white powder and whole drags:</p>		
	<p>a) General tests for carbohydrates</p>		
	<p>b) Preparation and examination of starches and related products.</p>		
	<p>c) Examination of gums:</p>		

	Acacia, tragacanth, sterculia agar and alginates.		
	4. Isolation of casein and lactose from milk.		

1. The cell, cell contents and cell types.

The cell - (a) some cellular organism, chalk & diatomite.(b) Fungi- Mucor or rhizopus, aspergillus, penicillium, ergot and yeast.

Cell contents - Starches and derivatives; calcium carbonate; silica.

Cell types - Parenchyma and modifications - colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiatae stem, parenchyma-pericyclic fibres jute, xylem fibers and vessels- liquorice, tracheids-pinus wood.

2. Epidermal cells and associated structures (trichomes, stomata etc.), leaves of belladonna, mentha, rosemary, senna, Indian hemp, digitalis etc. Seed trichomes- cotton and nux-vomica seeds; cork cells- cascara sagrada.

3. Study of some groups of unorganized white and off-white powder and whole drugs:

(a) General tests for carbohydrates

(b) Preparation and examination of starches and related products.

c) Examination of gums: Acacia, tragacanth, sterculia agar and alginates.

4. Isolation of casein and lactose from milk.

Books Recommended:

1. Pharmacognosy- Varro E. Tyler, Lynn R, Brady & James E, Robbers Lea & Febiger, Philadelphia.
2. Pharmacognosy- Trease & Evans.
3. Pharmacognosy- Edward P. Claus, Varro E.Tyler, 5th edition, Lea & Febiger, Philadelphia.
4. Textbook of Pharmacognosy- T. E. Wallis, J & A Churchill.
5. Practical Pharmacognosy- Rasheeduz Zafar, CBS Publishers.
6. Natural Products, A Laboratory Guide - Raphael Ikan, Acadec Press, Inc., London.

Course Profile:**Course Title: Bangladesh Studies****Course No: HUM-111 Credit Hour: 3 Contact Hours: 3 Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Part: I Society & Culture.		
	Part: II Bangladesh History		

Part: I Society & Culture

The sociology perspective, primary concepts, factors of social life, social structures and process, social institutions, culture and civilization, city and country, social change, problems of society, social problems of Bangladesh, urbanization process and its impact on Bangladeshi society will be covered.

Part: II Bangladesh History

The land, the geographical factor, and the people of Bangladesh, Historical perspectives: Ancient Bengal, Early Medieval Bengal, late Medieval Bengal, Beginning of British rule in Bengal, Nineteenth century Bengali Renaissance and area of social and religious reforms, partition of Bengal and its annulment, Bengal Politics in the 1930s Elections of 1936-37. Pakistan movement partition of Bengal (1947), Language movement (1952) Movement , Partition of Bengal (1947) Language movement (1952) Movement of autonomy, 6 point and 11 point programs. The 1970 election, Genocide in East Pakistan. The liberation War, the emergence of Bangladesh as a sovereign independent state in 1971.

Books Recommended:

1. Social and cultural history of Bengal, vol. 1 & 2, M. A. Rahim.
2. Democracy and Development in Bangladesh, Moudud Ahmed.
3. National cultural and heritage of Bangladesh, A. F. M. Salauddin Ahmed and Bazlul Mobin Chowdhury (ed.).
4. Society, politics and economics of Bangladesh, S. R. Chakraborty (ed.).

Course Profile:

Course Title: Viva- Voce

Course No: VV-111 **Credit Hour:** 1 **Contact Hours:** 1 **Total Marks:**

Rationale:

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Objectives:

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Second Year First Semester

Curriculum Structure

Course No.	Course Title	Credit Hours
PHARM-201	Organic Pharmacy-II	3
PHARM-202	Organic Pharmacy-II-Lab	1
PHARM-203	Pharmacognosy-II	3
PHARM-204	Pharmacognosy-II-Lab	1
PHARM-205	Basic Anatomy	1.5
PHARM-206	Physiology-I	3
PHARM-207	Physiology-I Lab	1
PHARM-208	Pharmaceutical Microbiology-I	3
PHARM-209	Pharmaceutical Microbiology-I-Lab	1
	Total Credit Hours	17.5

Course Profile:

Course Title: Organic Pharmacy-II

Course No: PHARM-201 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Chemistry of aromatic compounds.		
	a. Simple aromatic compounds.		
	b. Aromatic halogen compounds.		
	c. Aromatic nitro compounds.		
	d. Aromatic amino compounds.		
	e. Diazonium salts and related compounds.		
	f. Sulphonic acids.		
	g. Phenols.		
	h. Alcohols, aldehydes, ketones and quinines.		
	i. Aromatic acids.		

	2. Name reactions.		
	3. Carbohydrates.		
	4. Lipids.		
	5. Amino acids and proteins.		

1. Chemistry of aromatic compounds:

- a. Simple aromatic compounds
- b. Aromatic halogen compounds
- c. Aromatic nitro compounds
- d. Aromatic amino compounds
- e. Diazonium salts and related compounds
- f. Sulphonic acids
- g. Phenols
- h. Alcohols, aldehydes, ketones and quinines
- i. Aromatic acids

2. Name reactions: Arndt-Eistert/Bakelite, 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, Yilsmeier-Haack, Witting and Wolf-Kishner reduction -principle, reaction mechanism and pharmaceutical application of each of these reactions.

3. Carbohydrates: General considerations, chemistry, stereochemistry, classification, aldoses, ketones oxidation, effect of alkali, Kiliani-Fisher synthesis of aldoses, Ruff degradation, optical family, D, L, R, S cyclic structures of D(+) glucose, mutarotation, hemiacetal, acetal form of glucose, ring size determination, disaccharide, structure determination of polysaccharides, starch cellulose, glycogen, chemical and pharmaceutical importance of carbohydrate, blood sugar, glycogenesis, glycolysis, TCA cycle, metabolism of carbohydrates etc.

4. Lipids: General consideration, chemistry, biosynthesis of fats and fatty acid, catabolism of fat, fatty acid cycle, β -oxidation, catabolism of unsaturated fatty acids, ketone bodies, ketosis, ketouria, ketoacidosis, diabetic coma and its treatment, lactic acid and acidosis, phosphoglycerides steroid, bile salts etc.

5. Amino acids and proteins: General considerations, structure of amino acids, acidity and basicity of amino acids, isoelectric point, preparations and reactions of amino acids, essential amino acids, metabolism of amino acids-deamination, transamination, racemization etc.

Course Profile:

Course Title: Organic Pharmacy-II Lab

Course No: PHARM-202 **Credit Hour:** 1 **Contact Hours:** 1 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Identification of simple organic compounds through chemical tests.		
	2. Synthesis of simple compounds using name reactions.		

1. Identification of simple organic compounds through chemical tests.
2. Synthesis of simple compounds using name reactions.

Books Recommended:

1. *Organic Chemistry-* Robert Thornton Morrison and Robert Neilson Boyd, Prentice- Hall of India, Private Limited.
2. *A Textbook of Organic Chemistry-* Aran Bahl and B. S. Bahl, S. Chand & Company Ltd.
3. *Organic Chemistry, vol. I & II-* 1. L. Final, Long man, London.
4. *Organic Chemistry-* Louis Felser and Mary Feiser, Asia Publishing House, India.
5. *Advanced Organic Chemistry-* B. S. Bahl and Arab Bahl, S. Chand & Company Ltd.
6. *Introduction to Organic Laboratory Techniques-* Donald L, Pavia, Gary M. Lampman, George S. Kriz, Randall G. Engel, Thomson Brooks Cole.
7. *Advanced Organic Chemistry- Reactions, Mechanisms and Structure,* Jerry March, John Willey&Sons.
8. *A Text Book of Organic Chemistry-* Raj K. Barisal, New Age International (P) Limited.

Course Profile:

Course Title: Pharmacognosy-II

Course No: PHARM-203

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1.Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important local and foreign drugs of each group:		
	A) Glycosides and glycoside containing drugs, biosynthesis of glycosides the details of the following:		
	B) Alkaloids.		
	C) Volatile oils and related terpenoids.		
	D) Phenolic compounds and tannins.		
	E) Resin and resin combinations.		
	2. Herbs as health foods.		
	3. Poisonous		

	plants and natural pesticides.		
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PHARM-203

Pharmacognosy-II

Credit Hr: 3

1. Phytochemistry and pharmaceutical uses of the following plant constituents along with consideration of some important local and foreign drugs of each group:

A) Glycosides and glycoside containing drugs, biosynthesis of glycosides the details of the following:

- i. Cardiac - Digitalis, Strophanthus, Squill.
- ii. Anthraquinone glycosides - Cascara sagrada, Aloe, Senna, Rhubarb.
- iii. Saponins - Sarsaparilla, Glycyrrhiza, Dioscorea.
- iv. Cyanogenic- Wild cherry.
- v. Isothiocyanate - Mustard (Black mustard and white mustard).
- vi. Alcohol - Salix, Populus
- vii. Aldehyde- Vanilla
- viii. Lactose - Cantharis
- ix. Other glycosides and neutral principles - Gentian, Quassia, Saffron etc.

B) Alkaloids: Biosynthesis of Tropane, Quinoline, iso-quinolin and Indole alkaloids. The details of the followings -

- i) Pyridine- piperidine: Areca
- ii) Tropane - Belladonna, Stramonium, Hyoscyamus and Coca
- iii) Quinoline - Cinchona, Cuprea bark
- iv) Isoquinoline - Ipecac, Opium, Sanguinaria, Curare
- v) Indole - Rauwolfia, Nux vomica, Ergot, Catharanthus
- vi) Imidazole - Pilocarpus
- vii) Steroidal - Veratrum viride, Aconite
- viii) Purine base - Coffee, tea, Cocoa

C) Volatile oils and related terpenoids: Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oils used as drugs. Details of different types of volatile oils:

- i. Terpenes or sesquiterpenes - Turpentine, Juniper
- ii. Alcohols - Coriander, Sandalwood
- iii. Ester - Peppermint, Lavender, Rosemarry
- iv. Aldehydes - Cinnamon bark, Lemon peel
- v. Ketones - Spearmint, Caraway, Camphor
- vi. Phenols - Clove, Thyme, Cinnamon leaf
- vii. Ethers - Fennel, Nutmeg, Eucalyptus, Anise
- viii. Peroxides - Chenopodium
- ix. Others - Mustard, Wintergreen, bitter almond

D) Phenolic compounds and tannins: Chemical nature and tests for tannins, some tannin containing drugs such as Nutgall and Catechu. Classification, medicinal and commercial uses.

E) Resin and resin combinations (e.g. resin, oleoresin, oleo gum resin, balsam): Podophyllum, Jalap, Cannabis, Capsicum, Ginger, Myrrh, Tolu Balsam, and Benzoin.

2. Herbs as health foods: Alfa alfa, Apricot pits, Arnica, garlic, onion, Ginseng, Spiriluna Nigella, Fenugreek, Sassafras, Honey, etc.

3. Poisonous plants and natural pesticides: Datura, Poison Hemlock, Water Hemlock, Foxglove (Digitalis), Ipomoea, Tobacco, Poppy, Pyrethrum flower, Derris and Lanchocarpus, Red squill, Strychnine, etc.

Course Profile:

Course Title: Pharmacognosy-II Lab

Course No: PHARM-204

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Phytochemical 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, and Peppermint etc.		
	4. Detection of adulterants, (i.e. cotton seed, sesame and arachis oils) in olive oil.		
	5. Examination of Cod liver oil and detection of vitamin A in Cod liver oil.		
	6. Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe,		

	Senna and Rhubarb.		
	7. Isolation of lycopene from tomato.		
	8. Isolation of p-carotene from carrot.		
	9. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.		
	10. Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.		
	11. Study of alkaloids and some alkaloid containing drugs: Belladonna, Stramonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nuxvomica and Areca.		
	12. Physical and chemical tests for honey.		
	13. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.		

1. Phytochemical 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, and Peppermint etc.
4. Detection of adulterants, (i.e. cotton seed, sesame and arachis oils) in olive oil.
5. Examination of Cod liver oil and detection of vitamin A in Cod liver oil.
6. Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.
7. Isolation of lycopene from tomato.
8. Isolation of p-carotene from carrot.
9. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.
10. Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.
11. Study of alkaloids and some alkaloid containing drugs: Belladonna, Stramonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nuxvomica and Areca.
12. Physical and chemical tests for honey.
13. Study of some important medicinal and poisonous plants of Bangladesh.

Books Recommended:

1. Pharmacognosy- Varro E. Tyler, Lynn R, Brady & James E, Robbers, Lea & Febiger, Philadelphia.
2. Pharmacognosy- Trease & Evans.
3. Pharmacognosy- Edward P. Claus, Varro E. Tyler, Lea & Febiger, Philadelphia.
4. Textbook of Pharmacognosy- T. E. Wallis, J & A Churchill.
5. Practical Pharmacognosy- Rasheeduz Zafar, CBS Publishers.
6. Natural Products, A Laboratory Guide - Raphael Ikan, Acadec Press, Inc., London.

Course Profile:

Course Title: Basic Anatomy

Course No: PHARM-205

Credit Hour: 1.5

Contact Hours: 1.5

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Alimentary system.		
	2. Cardiovascular system.		
	3. Respiratory system.		
	4. Urinary system.		
	5. Reproductive system.		
	6. Nervous system.		
	7. Endocrine gland.		
	8. Exocrine gland.		
	9. Metabolic organ.		
	10. Reticulo endothelial system.		

1. Alimentary system-Oral cavity, pharynx, esophagus, stomach, small intestine, caecum, appendix, colon, sigmoid, rectum, anal canal.

2. Cardiovascular system- Heart, ascending aorta, arch of the aorta, descending thoracic **aorta**, abdominal aorta.

3. Respiratory system-Nose, pharynx, larynx, trachea, bronchus, lung.

4. Urinary system-Kidney, ureter, urinary bladder, urethra

5. Reproductive system-

Female-Ovary, uterus with fallopian tube, cervix, vagina.

Male- Testis, ductus deferens, seminal vesicle, prostate, urethra.

External genitalia: Male- scrotum, penis, Female-Labium majora, L.minora, clitories, vaginal

orifice.

6. Nervous system- CNS: Brain & spinal cord; PNS: spinal nerve & autonomic nervous system (sympathetic & parasympathetic)

7. Endocrine gland - Pituitary gland, thyroid & parathyroid gland, pancreas, adrenal gland, ovary, testis.

8. Exocrine gland - Parotid gland, submandibular gland, pancreas.

9. Metabolic organ - Liver with gall bladder.

10. Reticulo endothelial system - spleen, thymus, tonsil, lymph node, bone marrow.

Books Recommended:

1. Human Anatomy: Regional and applied Dissection and Clinical - Vol. 1, 2 & 3-Chaurasia, B. D.
2. Essentials of Anatomy & Physiology- Seeley, Rod R.
3. Gray's Anatomy- Spalding Gray, (International students edition), published by Churchill Livingstone.

Course Profile:

Course Title: Physiology-I

Course No: PHARM-206

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. General Physiology.		
	2. Tissue.		
	3. Blood system.		
	4. Cardiovascular system.		
	5. Digestive system.		
	6. Respiratory system.		

1. **General Physiology:** Physiology and its scope in pharmacy. Structure of cell, its various organelles and functions, cell division, body fluid compartments and its composition, transport across cell membrane and membrane potentials, haemostasis.

2. **Tissue:** Definition and classification of tissue. Definition, classification, characteristics, distribution, minute structures and functions of different tissue, bone and cartilage.

3. **Blood system:** Composition and functions of blood. Plasma and its components, plasma proteins and their functions. Blood coagulation, blood transfusion and blood groups, haemolysis, ESR. Blood forming cells- characteristics, functions, their formation and destruction. Haemoglobin- its structure, properties, function and haemoglobin derivatives. Anemia- definition and classification, causes and clinical features of various anemic conditions.

4. **Cardiovascular system:** Heart- Structure and blood circulation. Cardiac muscle, their **properties**, origin of heart beat and action potential. Cardiac cycle, heart sounds, cardiac output ECG, regulation of cardiac function. Blood pressure- types, significance, measurement and regulation. Hypertension-types and causes.

5. **Digestive system:** Structure of different parts of alimentary system, gastrointestinal motility and its control, swallowing and defecation. Secretion of digestive juices from saliva,

Gastric, pancreatic, intestinal glands and bile. Functions of digestive juices and their mechanism and regulation of secretions/digestion and absorption of various food stuff. Liver- its function, formation of bile and its circulation.

6. **Respiratory system:** Organs of respiratory system and its structure, inspiration and expiration, mechanism of respiration, pulmonary ventilation, ventilation volumes. Gaseous exchange through lungs, carriage of O_2 and CO_2 . Hypoxia- causes and classification.

Course Profile:

Course Title: Physiology-I Lab

Course No: PHARM-207

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Study of compound microscopes.		
	2. Microscopical study of blood cells: R.B.C., W.B.C. and platelets.		
	3. Estimation of hemoglobin.		
	4. Total count of R.B.C.		
	5. Total count of W.B.C.		
	6. Differential count of W.B.C.		
	7. Determination of clotting and bleeding times.		
	8. Examination of clot under tire microscope.		

	9. Effect of chemical agents on R.B.C.		
	10. Fragility test of R.B.C.		
	11. Determination of erythrocyte sedimentation rate (ESR).		
	12. Examination of Haemin crystals.		

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Books Recommended:

1. Medical Physiology by Ganon.
2. Practical Physiology by C. L. Ghai.
3. Human Physiology (vol. I and II)- Chadni Charan Chatterjee, Medical Allied Agency, Calcutta.
4. A Text Book of Medical Physiology- Arther C. Guyton, W. B. Sander's Company, Philadelphia 2nd edition, Appleton & Lange
5. Review of Medical Physiology- W. F. Ganong.
6. A Text Book of Practical Physiology- C.L. Ghai, South Asia Books.

Course Profile:

Course Title: Pharmaceutical Microbiology-I

Course No: PHARM-208

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction to microbiology.		
	2. History and evolution of microbiology.		
	3. Microscopic observations of microorganisms.		
	4. Bacteria		
	5. Microorganisms other than bacteria (Brief study)		
	6. Yeasts		
	7. Rickettsiae		
	8. Viruses		

1. **Introduction to microbiology:** Microbiology as a field of biology. Place of microorganisms in the living field. Prokaryotic and Eukaryotic protists. Groups of microorganisms, areas of microbiology, contributions of microbiology to pharmacy.

2. **History and evolution of microbiology:** Spontaneous generation and biogenesis, germ theory of diseases, pure culture concept, immunization, widening horizons.

3. **Microscopic observations of microorganisms:** Bright field, samples for field, fluorescence and phase contrast microscopy, electron microscopy, **preparations** of samples for microscopic examinations, wet mount and hanging drop **techniques**, fixed and stained smears. Microbiological stains, simple and differential **staining methods**.

4. **Bacteria:** Nomenclature of bacteria, morphology and fine structures, nutritional requirements. Bacteriological media. Growth and reproduction. Quantitative measurement of bacterial growth. Maintenance and prevention of pure culture of bacteria.

5. **Microorganisms other than bacteria (Brief study):**

Yeasts: Types, morphology, reproduction and physiology, pathogenic yeasts.

Rickettsiae: Introduction, characteristics of rickettsiae, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases.

Viruses: Virus inhibition, control of virus infections, bacterial virus of bacteriophages, morphology and composition, cultivation of bacterial viruses, reproduction of bacterial viruses.

Course Profile:

Course Title: Pharmaceutical Microbiology-I Lab

Course No: PHARM-209

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Identification and characterization of bacteria.		
	2. Staining of bacteria cells and spores.		
	3. Preparation of purebacterial cultures.		
	4. Preparation of pure culture and its identification.		
	5. Bacterial Culture.		
	6. Potency determination of antibiotics by microbial assay.		

	7. Determination of MIC by serial dilution technique.		
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1. Identification and characterization of bacteria.
2. **Staining** of bacteria cells and spores.
3. Preparation of pure bacterial cultures.
4. Preparation **of pure** culture and its identification.
5. Bacterial Culture.
6. Potency determination of antibiotics by microbial assay.
7. Determination of MIC **by** serial dilution technique.

Books Recommended:

1. Microbiology- Michael J. Pelczar, Noel R. Kreig and E.C,S Chan. Tata Me Graw Hill Publishing Company Limited, New Delhi,
2. Microbiology An Introduction- Tortara, Berdell R.Funkee & Case, Prentice-Hall.
3. Prescott and Dunn's Industrial Microbiology- Samuel Cate Prescott, Cecil Gordon Dunn and Gerald Reed-, Chapman & Hall.
4. Pharmaceutical Microbiology- Harris.
5. Cooper and Gunn's Dispensing for Pharmaceutical Students- S. J Carter, Pitman Medical.
6. Microbiology- Lachman and Whistriche.
7. Pharmaceutical Microbiology- W. B. Hugo & A. D. Russel, Blackwell Science.

Second Year Second Semester

Curriculum Structure

Course No.	Course Title	Credit Hours
PHARM-211	Physiology-II	3
PHARM-212	Physiology-II Lab	1
PHARM-213	Pharmaceutical Microbiology-II	3
PHARM-214	Pharmaceutical Technology-I	3
PHARM-215	Pharmaceutical Technology-I-Lab	1
PHARM-216	Pharmacology-I	3
PHARM-217	Pharmacology-I-Lab	1
PHARM-218	Biochemistry & Cellular Biology	3
PHARM-219	Biochemistry & Cellular Biology-Lab	1
VV-211	Viva-Voce	1
	Total Credit Hours	20

Course Profile:

Course Title: Physiology-II

Course No: PHARM-211 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Nervous System.		
	2. Endocrine System.		
	3. Excretory system.		
	4. Reproductive System.		
	5. Regulation of body temperature.		
	6. Metabolism.		

1. Nervous system: Neuron- properties, classification and functions. Neuroglial cells and their functions. Nerve fibres-Definition, types, properties of nerve fibres, origin and propagation of nerve impulses across nerve fibres, action potential. Synapse- classification, structure, properties and functions. Neurotransmitters- classifications and functions, nerve endings.

Different types of sensations- Mechanism and properties of sensations, Receptors- definition, classifications, properties and functions. Reflex and reflex arc, their classifications, properties and components of reflex arc. Principal division of nervous system - CNS and PNS. Functions of different parts of CNS. Ascending and descending tracts of spinal Cord. Differences between - somatic & autonomic, and sympathetic & parasympathetic nervous system. Cranial and spinal nerves & their functions. Regulation of autonomic nervous system. Muscle tone- definition & regulation. CSF- definition, composition and function.

2. Endocrine System: Different endocrine glands & their structure & functions of pituitary, thyroid, parathyroid, adrenal & pancreatic glands. Functions & regulation of secretion of hormones. Disorders of abnormal hormone secretions.

3. Excretory System: Structure of kidney, nephron & its different parts. Renal circulation- its regulation & measurements. Renal clearance & its importance. Urine- its composition & properties. Counter current mechanism. Role of kidney in acid-base balance of blood & in maintenance of plasma volume.

4. Reproductive System: Testis & accessory reproductive systems & their functions. Male hormones and their functions. Spermatogenesis and its hormonal regulation. Organs of female reproduction system and their functions. Menstruation cycle, different phases & its regulation. Oogenesis & ovulation and its control. Female sex hormones & their functions, Pregnancy and lactation & their hormonal control.

5. Regulation of body temperature: Heat production & heat dissipation. Role of hypothalamus & other nerve factors in body temperature regulation. Abnormalities in body temperature regulation.

6. Metabolism: Fat, carbohydrate, protein and nucleoprotein metabolism; Metabolic pathways of fat, carbohydrates and proteins; Enzymes, vitamins and hormones regulation various metabolic steps; Vitamins and minerals: their physiological properties and functions.

Course Profile:

Course Title: Physiology-II Lab

Course No: PHARM-212

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Recording of normal heart beat in toad.		
	2. Demonstration of the effects of temperature on toad heart.		
	3. Demonstration of the effects of stannous ligatures on toad heart.		
	4. Demonstration of the effects of drugs on toad heart.		
	5. Demonstration of the effect of electrolytes (Na ⁺ , K ⁺ , Ca ⁺) on toad heart.		
	6. Recording of respiration with stethograph. Effects of physical exercise on B.P. and heart rate.		

	7. Measurement of B.P. with sphygmomanometer. Effects of physical exercise on B.P. and heart rate.		
	8. Biochemical tests on saliva: Effect of ptyalin on starch.		
	9. Collection of gastric juice; Test for gastric acidity.		
	10. Estimation of blood sugar in normal person.		

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2. Demonstration of the effects of temperature on toad heart.

3. Demonstration of the effects of stannous ligatures on toad heart.

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Books recommended:

1. Medical Physiology by Ganon.

2. Practical Physiology by C. L. Ghai.

3. Human Physiology (vol. I & II)- Chandi Charan Chatterjee, Medical Allied Agency, Calcutta.

4. A Text Book of Medical Physiology- Arther C. Guyton, W. B. Sander's Company, Philadelphia 2nd edition, Appleton & Lange

5. Review of Medical Physiology- W. F. Ganong.

6. A Text Book of Practical Physiology- C.L. Ghai, South Asia Books.

Course Profile:

Course Title: Pharmaceutical Microbiology-II

Course No: PHARM-213 **Credit Hour:** 3 **Contact Hours:** 3 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Immunity & immunological products.		
	2. Introduction to sterilization.		
	3. Sterility Testing.		
	4. Aseptic techniques.		
	5. Microbial contamination of pharmaceutical products.		
	6. Evaluation techniques in microbiology.		
	7. Industrial microbiology.		

1. Immunity & immunological products: Immunity, primary & secondary defensive mechanism of body, microbial resistance, interferon, preparations of official immunological products (vaccines & sera).

2. Introduction to sterilization: Definition, importance & types of sterilization.

Sterilization techniques:

i) Heat (Dry & Moist) ii) Gas iii) Filtration iv) Radiation v) Chemicals

3. Sterility Testing: Significance, factors influence the design of sterility tests, sampling, control test, inactivation of antibacterial, filtration techniques in sterility testing, mechanism, advantages & disadvantages of filtration, tests on aqueous solutions.

4. Aseptic techniques: Aim & Importance of Aseptic Techniques, Design of an asepsis laboratory, methods of ventilation, testing of efficiency of air, Laminar air flow

5. Microbial contamination of pharmaceutical products: Source, evaluation, prevention control etc.

6. Evaluation techniques in microbiology: Methods of evaluation, microbiological assay of disinfectant and antibiotic principles, methodology, features of the assay.

7. Industrial microbiology: Industrial microbiology processes, micro-organisms used in industrial processes, industrial uses of bacteria, yeast and molds to prepare alcohol, lactic acid, vinegar, citric acid, penicilline etc.

Books Recommended:

1. Microbiology- Michael J. Pelczar, Noel R. Kreig and E.C,S Chan. Tata Me Graw Hill Publishing Company Limited, New Delhi,
2. Microbiology An Introduction- Tortara, Berdell R.Funkee & Case, Prentice-Hall.
3. Prescott and Dunn's Industrial Microbiology- Samuel Cate Prescott, Cecil Gordon Dunn and Gerald Reed-, Chapman & Hall.
4. Pharmaceutical Microbiology- Harris.
5. Cooper and Gunn's Dispensing for Pharmaceutical Students- S. J Carter, Pitman Medical.
6. Microbiology- Lachman and Whistriche. Pharmaceutical Microbiology- W. B. Hugo & A. D. Russel, Blackwell Science.

Course Profile:

Course Title: Pharmaceutical Technology-I

Course No: PHARM-214 **Credit Hour:** 3 **Contact Hours:** 3 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Pre-formulation.		
	2. Pharmaceutical Incompatibilities.		
	3. Pharmaceutical excipients.		
	4. Basic principle of compounding and dispensing.		
	5. Liquid dosage forms.		
	6. Disperse systems		
	a) Properties of disperse system.		
	b) Suspension.		
	c) Emulsion.		
	7. Semisolids (Ointments, paste, gels)		
	8. Suppositories		

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 determination, pH, solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability.

2. Pharmaceutical incompatibilities: Introduction, types of incompatibilities, general methods of incompatibilities, method of correction of incompatibilities.

3. Pharmaceutical excipients: Chemistry, physical properties and uses of following excipients, acidifying agents, air displacement agents, alkalizing agent, antifoaming agents, antimicrobial preservatives, antioxidants, buffering agents, chelating agent, colors, complexing agents, emulsifying agents.. Having a get its and perfumes humectant, ointment bases, solvents^ stiffening agents, wetting and solubilizing agents.

4. Basic principles of compounding and dispensing: Weight, measures and units, calculation for compounding and dispensing, fundamental operation in compounding, good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription, labeling of dispensed medications.

5. Liquid dosage forms: Solution and elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation consideration, manufacturing considerations, packaging of liquids, preservation and stability aspects, quality control of liquid prepare, ii ens.

6. Dispersed systems:

(a) **Properties of dispersed system:** Theoretical aspects of suspension, emulsion and colloids, surface charge and zeta potential, inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence

(b) **Suspension:** Advantages and disadvantages, aggregated and dispersed system, suspending agents, formulation of suspension, manufacturing of suspensions, stability of suspensions, evaluation and quality analysis of suspensions. Rheological consideration, illustrative examples

(c) **Emulsion:** Definition and applications, advantages and disadvantages, theory of emulsion, formation of emulsion, classification of emulsifying agents. HLB values of surface active agents, formulation of emulsions, manufacturing of emulsions, stability of emulsions, evaluation and quality analysis of emulsions. Rheological consideration, illustrative examples.

7. Semisolids (Ointments, paste, gels): Structure of skin, percutaneous absorption of drugs, definition and classification of semisolids, classification of ointment bases, formulation of ointments, manufacturing of ointments, rheological consideration, evaluation and quality analysis of ointments.

8. Suppositories: Drug absorption from colon, classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, testing of suppositories.

Course Profile:

Course Title: Pharmaceutical Technology-I Lab

Course No: PHARM-215

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Preparation of percentage solution and calculation.		
	2. Preparation of aromatic water.		
	3. Preparation of syrup		
	(a) Phenobarbitone-Na syrup		
	(b) Chlorpheniramine maleate syrup		
	(c) Promethazine HCl syrup		
	(d) Iron syrup.		
	4. Preparation of elixirs.		
	5. Preparation of suspension		
	(a) Paracetamol suspension		
	(b) Antacid suspension		
	(c) Chalk powder suspension.		
	(d) Cotrimoxazole suspension.		
	6. Preparation of emulsion and determination of type of		

	emulsion		
	(a) Primary emulsion by dry gum method and wet gum method.		
	(b) Castor oil emulsion.		

1. Preparation of percentage solution and calculation.

2. Preparation of aromatic water.

3. Preparation of syrup

(a) Phenobarbitone-Na syrup

(b) Chlorpheniramine maleate syrup

(c) Promethazine HCl syrup

(d) Iron syrup.

4. Preparation of elixirs.

5. Preparation of suspension

(a) Paracetamol suspension

(b) Antacid suspension

(c) Chalk powder suspension.

(d) Cotrimoxazole suspension.

6. Preparation of emulsion and determination of type of emulsion

(c) Primary emulsion by dry gum method and wet gum method.

(d) Castor oil emulsion.

Books recommended:

- 1. The Theory and Practice of Industrial Pharmacy by Lachman.**
- 2. American Pharmacy by Sprowl.**
- 3. Pharmaceutics by Aulton.**
- 4. Remington's Pharmaceutical Sciences.**
- 5. Dispensing of medication by Husa and Martin.**
- 6. Pharmaceutical Practice by Aulton.**
- 7. An Introductory to Pharmaceutical Formulations by Fishburn.**
- 8. An Introduction of Pharmaceutical Production.-: by Fishburn.**
- 9. The Extra Pharmacopeia by Martindale.**

Course Profile:

Course Title: Pharmacology-I

Course No: PHARM-216 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. General Pharmacology.		
	2. Autacoids and inflammation.		
	3. Drugs used in respiratory system.		
	4. Drugs used in gastrointestinal system.		
	5. Drugs acting on blood and blood forming organ.		
	6. Vitamins.		

1.General pharmacology

a) **Pharmacological definitions:** Pharmacology, clinical pharmacology, scopes of pharmacology, historic development, the pharmacopeias, drugs-nomenclature, generic and branded drug, pro-drugs, source and nature of drugs, properties of ideal drugs. Ethics, over the counter drugs, prescription drugs. Prescription, parts of prescription, prescription incompatibilities, dispensing, agonists, antagonists, synergism, side effects, drugs toxicities, drug interactions.

b) **Dose, dosage forms and routes of administration of drugs:** Drug absorption-factors affecting the drug absorption, plasma membrane, passage of drugs across membrane,

simple diffusion, filtration, facilitated diffusion, active transport, .passive transport, site of absorption, bioavailability, distribution of drugs, protein binding, accumulation and storage in body, drug dilution in body fluids, metabolism of drugs, excretion of drugs.

c) Basic concept of drug action, receptor, nature of receptor, drug antagonism, relation between drug dose & clinical response.

d) Signalling mechanism and drug action, legand gated channels, G-proteins and second messengers.

2. Autacoids and inflammation: Introduction, general characteristics, classification, physiological role of autacoids, pharmacological action, uses, side effects and structure activity relationships of the following autacoids and antagonists: Histamine, Bradykinin and their antagonists. Lipid-derived autacoids like Eicosanoids and platelet activating factors and their antagonists. Non-narcotic analgesics- Antipyretic and Anti-inflammatory agents and their uses in gout.

3. Drugs used in respiratory disorders: Introduction, classification, chemistry, mode of action, SAR, pharmacokinetics, indications, and contraindications, dose, adverse effects and drug interactions of individual class of following drugs: Anti-tussive and Anti-asthmatic agents.

4. Drugs used in gastrointestinal disorders: Introduction, classification, chemistry, mode of action, SAR, pharmacokinetics, indication, and contraindications, dose, adverse effects .and drug interaction of individual class of following drugs: H₂ receptor antagonists, proton-pump inhibitor, Ulcer coating drugs, Anticholinergic effecting PUD, Anti- *H. pylori* drugs, Antacids, Anti-emetics, Purgatives, Antidiarrheal drugs, Antispasmodics.

5. Drugs acting on blood and blood forming organs: Hematinics, Anticoagulants, Antithrombotics, Fibrinolytics, Tissue plasminogen antagonists, Hypolipidemic drugs.

6. Vitamins: Introduction, classification, sources, stability of vitamins, deficiency disorders, therapeutic and pharmaceutical use, mechanism of actions.

Course Profile:

Course Title: Pharmacology-I Lab

Course No: PHARM-217

Credit Hour: 1 Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Different route of administration of drug in experimental animals.		
	2. Handling of experimental, animal: Mice and rat		
	3. Estimation of blood uric acid level by enzymatic method.		
	4. Determination of plasma proteins by the Biuret Method (Method of Reinhold).		
	5. Estimation of Cholesterol in Human blood by Enzymatic method.		
	6. Estimation of Cholesterol in Human Blood by chemical method.		

1. Different route of administration of drug in experimental animals.
2. Handling of experimental, animal: Mice and rat
3. Estimation of blood uric acid level by enzymatic method.

4. Determination of plasma proteins by the Biuret Method (Method of Reinhold).
5. Estimation of Cholesterol in Human blood by Enzymatic method.
6. Estimation of Cholesterol in Human Blood by chemical method.

Books Recommended:

1. Goodman & Gillman's Pharmacological Basis of Therapeutics- Hardman, Joel G., McGraw Hill Incorporated.
2. Basic and Clinical Pharmacology- Bertram G. Katzung, Me Graw Hill Companies.
3. Medical Pharmacology-Andres Goth, Toppan Co. Ltd.
4. Pharmacology & Pharmacotherapeutics- R. S. Satosker, Popular Prakashani Ltd. India.
5. Clinical Pharmacology- D, R. Laurence, P. N. Bennett and M. J. Brown, Churchill Living stone.
6. Clinical Pharmacy and Therapeutics, Roger walker and CUve Edwards,Churchill Living stone.

Course Profile:

Course Title: Biochemistry & Cellular Biology

Course No: PHARM-218

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction to cell.		
	2. Plasma membrane/cell walls and cell surface.		
	3. Nuclear structure and function.		
	4. Protein.		
	5. Nucleic acid.		
	6. Enzymes.		

1. Introduction to cell: Differences between prokaryotic cells and eukaryotic cells, structure and functions of mitochondria and chloroplasts, cytoskeleton, cell development and differentiation.

2. Plasma membrane/cell walls and cell surface: Principle of semi-permeability, active transport, endocytosis, exocytosis, bacterial, fungal and plant cell walls.

3. Nuclear structure and function: Cell division and cell cycle, mitosis and meiosis, structure and function of chromosomes.

4. Proteins: Important bonds in protein, important functions of protein in biological system, importance of amino acid sequence in protein structure, different amino acids, structures and functions, peptide bond, disulfide bridge in protein structure, peptide bond is rigid and planner, a helix, p sheet, hairpin turn, denaturation "and renaturation of proteins, proteins are rich in hydrogen-bonding potentiality, different structures of proteins, conformational change of protein, gel electrophoresis,' 2-D gel electrophoresis, purification of protein, synthesis of protein, protein sequencing, recombinant DNA technology for protein sequencing.

5. Nucleic acids: Importance of nucleic acid study, different bases of DNA/RNA, nucleotide, nucleoside, structures of DNA, DNA chain has polarity, AT/GC structure, melting point of DNA, physical states of DNA, replication, discovery of DNA polymerase I and III, mRNA, hybridization studies of mRNA, synthesis of mRNA, recombinant DNA technology, restriction enzymes, promoter region of DNA, RNA synthesis termination, tRNA, role of tRNA in protein synthesis, codons, DNA sequencing.

6. Enzymes: Definition, activation energy and enzymes, enzymes' are highly specific, regulation of enzymes activity, enzymes and reaction equilibria, enzyme kinetics, enzyme inhibition, common features of enzymes, enzyme cofactors/coenzymes, Vit B₁, Vit B₂ etc as coenzyme.

Course Profile:

Course Title: Biochemistry & Cellular Biology Lab

Course No: PHARM-219

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Determination of protein content of blood by Spectrophotometric method		
	2. Determination of extinction coefficient of protein.		
	3. Identification and molecular weight determination of protein by SDS-PAGE.		
	4. Identification of DNA by agarose gel electrophoresis.		
	5. Synthesis of DNA by PCR method.		
	6. Determination of lipid profiles.		
	7. Determination of serum creatinine level.		
	8. Determination of blood urea level.		
	9. Determination of SGPT, SCOT levels in blood.		

1. Determination of protein content of blood by Spectrophotometric method
2. Determination of extinction coefficient of protein.
3. Identification and molecular weight determination of protein by SDS-PAGE.
4. Identification of DNA by agarose gel electrophoresis.
5. Synthesis of DNA by PCR method.
6. Determination of lipid profiles.
7. Determination of serum creatinine level.
8. Determination of blood urea level.
9. Determination of SGPT, SCOT levels in blood.

Books Recommended:

1. Biochemistry, 5th ed., J.M. Berg, J.L. Tymoczko and L. Stryer, Freeman.
2. Molecular Cell Biology, Lodish. H., et al. J
3. Essential Cell Biology, B. Alberts et al. Pub. Garland.
4. Amazing Schemes within your Genes, Balkwill and Ralph, Collins
5. Instant Notes in Biochemistry. Hames, Hooper and Houghton, Bios Scientific Publishers.
6. Biochemistry - Leninger

Course Profile:

Course Title: Viva-voce

Course No: VV-211 Credit Hour: 1 Contact Hours: 1 Total Marks:

Rationale:

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Objectives:

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Third Year First Semester

Curriculum Structure

Course No.	Course Title	Credit Hours
PHARM-301	Pharmaceutical Analysis-I	3
PHARM-302	Pharmaceutical Analysis-I-Lab	1
PHARM-303	Pharmaceutical Technology-II	3
PHARM-304	Pharmaceutical Technology-II-Lab	1
PHARM-305	Pharmacology-II	3
PHARM-306	Pharmacology-II-Lab	1
PHARM-307	Medicinal Chemistry-I	3
PHARM-308	Medicinal Chemistry-I-Lab	1
PHARM-309	Pathology	3
PHARM-310	Nutraceuticals, Dietary Supplements and Herbal Products	1.5
	Total Credit Hours	20.5

Course Profile:

Course Title: Pharmaceutical Analysis-I

Course No: PHARM-301 **Credit Hour:** 3 **Contact Hours:** 3 **Total Marks:**

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction and techniques of pharmaceutical analysis.		
	2. Aqueous acid-base titration.		
	3. Non aqueous acid-base titration.		
	4. Oxidation-reduction titration.		
	5. Complexometric titration.		
	6. Aquametry.		

1. Introduction and techniques of pharmaceutical analysis

A) Introduction: Selection of samples, selection of chemicals.

B) The arts and science of pharmaceutical analysis: Choosing the tools, identification of containers, filtration, ignition of precipitates, drying of samples, recording units.

2. Aqueous acid-base titration: Definition, distribution of acid-base species with pH of the medium, acid-base titrimetry for determination of weakly acidic and basic pharmaceuticals, Indicators (theories) and their selection, applications.

3. Non aqueous acid-base titration: Theoretical considerations and principles, Bronsted-Lowry theory of acids and bases, non aqueous solvents, titration of weak acids and weak bases, applications and scopes of non aqueous titration.

4. Oxidation-reduction titration: Principles and concepts, determination involving potassium permanganate, potassium dichromate, potassium bromate, Iodometry and iodometric determination, miscellaneous oxidation and reduction titration, indicators, applications.

5. Complexometric titration: Introduction to complexometric titration, complexes and chelates, stability of complex ions, titration based on complex formation, types of complexometric titration, techniques employed in chelometric titration, methods of end point detection, titration selectivity and masking agents.

6. Aquametry: Principle and scope, Physical methods of water determination, chemical method of water determination, Karl-Fischer procedure -principle, chemistry, methodology, equipment, end point detection and limitations.

Course Profile:

Course Title: Pharmaceutical Analysis-I Lab

Course No: PHARM-302 Credit Hour: 1 Contact Hours: 1 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Assay of acetyl salicylic acid in aspirin tablets.		
	2. Non-aqueous assay of phenobarbitone tablets.		
	3. Determination of potency of penicillin tablets.		
	4. Determination of calcium in solid and liquid dosage forms by complexometric titration.		
	5. Assay of promethazine hydrochloride.		
	6. Assay of aluminium hydroxide gel.		
	7. Assay of magnesium and aluminium from antacid preparations.		
	8. Determination of iodine value and saponification value of fixed oils.		

1. Assay of acetyl salicylic acid in aspirin tablets.
2. Non-aqueous assay of phenobarbitone tablets.
3. Determination of potency of penicillin tablets.
4. Determination of calcium in solid and liquid dosage forms by complexometric titration.
5. Assay of promethazine hydrochloride.
6. Assay of aluminium hydroxide gel.
7. Assay of magnesium and aluminium from antacid preparations.
8. Determination of iodine value and saponification value of fixed oils.

Books Recommended:

1. A Textbook of Pharmaceutical Analysis- Kenneth A. Connors, John Wiley & Sons.
2. Pharmaceutical Chemistry- Lasie G. Chatten, Marcel Dekker Inc.
3. A Textbook of Quantitative Inorganic Analysis, Vol. I & II- Arthur I. Vogel, Longman, England.
4. United States Pharmacopoeia, United States Pharmacopoeia Convention, Inc.
5. British Pharmacopoeia.
6. Quality Control in Pharmaceutical Industry- Murray S. Cooper, Academic Press.
7. Organic Spectroscopy- Philip Crews, Jamie Rodriguez & Marcel Jaspurs, Oxford University Press, New York, London.
8. Practical Pharmaceutical Chemistry, Parts I and 2, By A. H. Backett & J. B. Stenlake, Athlone Press, London.
9. Introduction to Organic Laboratory Techniques- A Contemporary approach, D. L. Pavia, G. M. Lampman, G. S. Kriz, W. B. Saunders Company, Philadelphia, London, Toronto.

Course Profile:

Course Title: Pharmaceutical Technology II

Course No: PHARM-303

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Formulation and manufacturing of tablets.		
	2. Common tableting problems and evaluation of tablets.		
	3. Tablet coating.		
	4. Hard gelatin capsules.		
	5. Soft gelatin capsules.		
	6. Microencapsulation technology.		

1. Formulation and manufacturing of tablets: manufacturing of tablets by wet granulation, dry granulation and by direct compression. Definition, advantages and disadvantages, tablet dosage form, granulation of powders for tableting, advantages and disadvantages of different process, processing machineries used in tablet manufacturing, packaging of tablets.

2. 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 methods in tablet manufacturing, Study of common tableting problems.

3. 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, other excipients; 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.

4. 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.

5. Soft gelatin capsules: Definitions and classifications, advantages and limitations, properties of soft capsules, formulation of soft capsules, manufacturing of soft capsules, **problems** in soft capsule manufacturing, quality control methods of soft capsules, packaging **of soft** capsules.

6. Microencapsulation technology: Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.

Course Profile:

Course Title: Pharmaceutical Technology II Lab

Course No: PHARM-304

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Formulation and compounding of different suspensions.		
	2. Formulation and compounding of different emulsions.		
	3. Formulation and compounding of ointments.		
	4. Study of different compounds of a 16-station rotary table press.		
	5. Formulation and manufacturing of antihistamine tablets.		
	6. Formulation and manufacturing of dispersible aspirin tablet		
	7. Evaluation of physical parameters of tablet.		

1. Formulation and compounding of different suspensions.
2. Formulation and compounding of different emulsions.
3. Formulation and compounding of ointments.
4. Study of different compounds of a 16-station rotary table press.

5. Formulation and manufacturing of antihistamine tablets.
6. Formulation and manufacturing of dispersible aspirin tablet
7. Evaluation of physical parameters of tablet.

Books recommended:

- 1 The Theory and Practice of Industrial Pharmacy by Lachman.
2. American Pharmacy by Sprowl.
3. Pharmaceutics by Aulton.
4. Remington's The science and practice of pharmacy
5. Dispensing of medication by Husa and Martin.
6. Pharmaceutical Practice by Aulton.
7. An Introductory to Pharmaceutical Formulations by Fishburn.
8. An Introduction of Pharmaceutical Productions by Fishburn.
9. The Extra Pharmacopeia by Martindale.

Course Profile:

Course Title: Pharmacology-II

Course No: PHARM-305

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Drugs acting on ANS.		
	A. Drug affecting parasympathetic nervous system.		
	B. Drugs affecting sympathetic nervous system.		
	2. Drugs acting on CNS.		
	i. General and local anaesthetics.		
	ii. Sedative and hypnotics.		
	iii. Drugs used in the treatment of psychotic disorder.		
	iv. Anti-epileptic and Anti-perkinsonian drugs.		
	v. Drugs effective in the therapy of		

	migraine.		
	vi. Opioid analgesics and antagonist.		

1. Drugs acting on ANS:

A. Drugs affecting parasympathetic nervous systems: Cholinergic agonists, natural compounds and synthetics, anticholinesterase: Physostigmine, Neostigmine, Antimuscarinic drugs: Atropine, Scopolamine, and Quaternary ammonium compounds.

B. Drugs Affecting sympathetic nervous system – Catecholamines: Epinephrine, Norepinephrine

Non-Catecholamines: Isoproterenol and related compounds having therapeutic importance.

α -adrenergic blockers: Prazosin, Tolazoline, Ergot alkaloids etc

β -adrenergic blockers: Propranolol, Atenolol, Metoprolol, Acetobutol etc

Drugs interfering with adrenergic function: Clonidine, Methyldopa etc

Ganglion stimulants & blockers: Nicotine, Lobeline, Hexamethonium, Pentolinium, Trimethaphen etc.

2. Drugs acting on CNS:

A. Neurotransmission & CNS: Macrofunction of the brain region, Integrative chemical communication in the CNS, neurotransmitter, neurohormone, neuromodulator, central neurotransmitter, other regulatory substances (Purines & Cytokines).

B. Pharmacological action, mechanism of action, uses & side effects and structure activity relationship of the following categories of centrally acting drugs:

- i. General and local anesthetics.
- ii. Sedatives and hypnotics
- iii. Drug used in the treatment of psychotic disorders
- iv. Anti-epileptic and anti-parkinsonian drugs
- v. Drugs effective in the therapy of migraine
- vi. Opioid analgesics and antagonists.

Course Profile:**Course Title: Pharmacology-II Lab****Course No: PHARM-306****Credit Hour: 1 Contact Hours: 1****Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Study of drugs acting on CNS.		
	(a) CNS stimulant drugs (strychnine, ephedrine, amphetamine).		
	(b) CNS depressant drugs (Barbiturates induced sleeping time).		
	2.Effect of pilocarpine on saliva secretion of rat.		
	3. Effect of digitalis, adrenaline, nor adrenaline, isoprenaline on toad's heart.		
	4. Effect of local anesthetics on rats tail.		
	5. Study of mydriatic and myotic effects on rabbit's eye (e.g. Pilocarpine, atropine, physostigmine etc.).		

Books Recommended:

1. Goodman & Gillman's Pharmacological Basis of Therapeutics- Hardman, Joel G., McGraw Hill Incorporated.
2. Basic and Clinical Pharmacology- Bertram G. Katzung, Mc Graw Hill Companies.
3. Medical Pharmacology-Andres Goth, Toppan Co. Ltd.
4. Pharmacology & Pharmacotherapeutics- R. S. Satosker, Popular Prakashani Ltd. India.

5. Clinical Pharmacology- D, R. Laurence, P. N. Bennett and M. J. Brown, Churchill Living stone.
6. Clinical Pharmacy and Therapeutics, Roger walker and Clive Edwards, Churchill Living stone.

Course Profile:

Course Title: Medicinal Chemistry-I

Course No: PHARM-307

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Influence of physicochemical properties on biological action.		
	2. Stereochemistry .		
	3. Heterocyclic chemistry.		
	4. Chemistry, SAR, mode of action, synthesis, and biochemical approaches to drug design (where applicable) and physico-chemical properties of following groups of drugs		

	a. Hypnotics and sedatives		
	b. Antihistamines		
	c. Analgesics and anti-inflammatory agents		
	d. Cardiovascular agents		
	e. Diuretics		
	5. Natural products and other secondary metabolites		
	a) Vitamins.		
	b) Alkaloids.		
	c) Glycosides.		

1. Influence of physicochemical properties on biological action: Effect of pH, ionization, dissolution and surface active agents.

2. Stereochemistry:

- General treatment of different types of isomerism.
- 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, optical rotation.
- Asymmetric synthesis: preparation of enantiomer by asymmetric synthesis and optical resolution method.
- Stereoselective and stereospecific reaction.
- Pharmaceutical importance of studying stereochemistry.

3. Heterocyclic chemistry:

- 5-membered heterocyclic compounds: Pyrrole, Furan, Thiophene, Pyrazole, Imidazole, Oxazole, Isoxazole, Thiazole and Isothiazole: their preparations, reactions and pharmaceutical importance.
- 6-membered heterocyclic compounds: Pyridine, piperidine, pyrimidine, pyridazine, pyrazine and triazine: their preparations, reactions and pharmaceutical importance.
- Benzofused 5-membered heteroatomic compounds: Indole, berberine, benzothiaphene and carbazole: their chemistry, synthesis and pharmaceutical importance.
- Benzofused 6-membered heteroatomic compounds: Quinolines and isoquinolines: their chemistry, synthesis and pharmaceutical importance.

4. Chemistry, SAR, mode of action, synthesis, and biochemical approaches to drug design (where applicable) and physico-chemical properties of following groups of drugs:

- a. Hypnotics and sedatives
- b. Antihistamines
- c. Analgesics and anti-inflammatory agents
- d. Cardiovascular agents
- e. Diuretics

5. Natural products and other secondary metabolites:

a) Vitamins: The clinical aspects of vitamins and their effects on free radicals, **synthesis of** vitamins such as Vit-B₁, Vit-C, nicotinamide, pyridoxine, mechanisms of the action of vitamins.

b) Alkaloids: Alkaloids as pharmaceutical raw materials, opium and **analogues of opium**, Synthesis of papaverine and ephedrine, clinical comparison of ephedrine and epinephrine.

c) Glycosides: Clinical and chemical aspects of digoxin and other digitalis glycosides.

Course Profile:**Course Title: Medicinal Chemistry-I Lab****Course No: PHARM-308****Credit Hour: 1 Contact Hours: 1****Total Marks:****Rationale:**
.....**Objectives:**
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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Synthesis of drug and drug intermediates		
	1. Paracetamol		
	2. Benzocaine		
	3. Aspirin		
	4. Phenacetin		
	5. PABA (Para Amino Benzoic Acid)		
	6. Methyl salicylate		

Synthesis of drug and drug intermediates:

1. Paracetamol
2. Benzocaine
3. Aspirin
4. Phenacetin
5. PABA (Para Amino Benzoic Acid)
6. Methyl salicylate

Books Recommended

1. Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry-Jaime N. Delgado & William A. Remers, LippincottRaven, Philadelphia Newyork.
2. Burger's Medicinal Chemistry and Drug Discovery- Donald J. Abraham, John **Wiley and Sons**.
3. Essentials of Medicinal chemistry- Andrejus Korolkovas, John Wiley and Sons.
4. Heterocyclic Chemistry- J. A. Joule and G. F. Smith, English Language **book Society**.

5. Foye's Principles of Medicinal Chemistry- David A. Williams and **Thomas L. Lemke**, Lippincott Williams & Wilkins.
6. Medicinal Chemistry: Principles and Practice- Frank D King, The Royal Society **of** Chemistry.
7. An Introduction to Medicinal Chemistry- Graham L. Patrick, Oxford **University Press**.

Course Profile:

Course Title: Pathology

Course No: PHARM-309

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Definition and scopes of pathology, concept of diseases.		
	2. Cellular injury and adaptation.		
	3. Inflammation and Repair.		
	4. Infectious disease.		
	5. Nutritional diseases.		
	6. Diseases of the blood vessel.		
	7. Heart disease.		
	8. Hemodynamic disorders.		
	9. Neoplasia.		

1. Definition and scopes of pathology, concept of diseases
2. Cellular injury and adaptation: Morphology of injured cells, intracellular accumulation, sub-cellular alteration, adaptation, and 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. Infectious disease: Herpes simplex, AIDS, diphtheria, whooping cough, tuberculosis, syphilis, plague, tetanus, giardiasis, trichomoniasis, pneumonia, filariasis, etc.
5. **Nutritional diseases:** Marasmus-kwashiorkor, deficiency states of vitamins and minerals.
6. **Diseases of the blood vessel:** Thrombosis, varicose vein, arteriosclerosis, stroke.
7. **Heart disease:** Ischemia, carditis, congestive cardiac failure, angina pectoris, myocardial infarction, congenital heart disease, rheumatic heart disease, rheumatic fever.
8. **Hemodynamic disorders:** Edema, hyperemia, congestion, hemorrhage, hemostasis, thrombosis, embolism, shock.
9. **Neoplasia:** Characteristics, grading and stages of cancer, metastasis, karyotype changes in tumour, carcinogenic agents and their cellular interaction, oncogenes and cancer, sarcomas.

Books Recommended:

1. Robbins's Pathological Basis of Disease- Ramzi S. Cotran, Vinay Kumar, Tucker Collins, Stanley L. Robbins, W.B Sander's Company, Philadelphia.
2. General Pathology- J. B Walter & M. S Israel, -) Churchill Livingstone, Edinburgh.

Course Profile:

Course Title: Nutraceuticals, Dietary Supplements and Herbal Products

Course No: PHARM-310

Credit Hour: 1.5

Contact Hours: 1.5

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction.		
	2. Food Science and nutrition.		
	3. Food components and nutrition.		
	4. Food, nutrition, health and disease.		
	5. Nutraceuticals in herbal products.		
	6. Food processing and food products developments.		
	7. Quality assurance of nutraceuticals, dietary supplements & herbal products.		
	8. Food Biotechnology.		

1. Introduction.

- 2. Food Science and nutrition:** Overview on medical foods, nutraceuticals, function foods and dietary supplement.
- 3. Food components and nutrition:** Food composition, macronutrients, micronutrients, protein, carbohydrate, fats and oils, vitamins, minerals, dietary fibers and fiber-like ingredients, trans fatty acid and omega 3,6,9 fatty acid, sugar and fat substitutes.
- 4. Food, nutrition, health and disease:** Relationship of nutrition and healthy dietary guidelines/food pyramid, food habit and obesity, effects of trans and omega 3,6,9 fatty acid on health and diseases.
- 5. Nutraceuticals in herbal products:** Fruits, vegetables and grains with health benefits; effects of nutraceuticals in cancer, immune system, phytochemicals and roles in prevention of specific diseases) .Antioxidant, antidiabetic, anti-inflammatory and hypolipidemic herbs and nutraceuticals.
- 6. Food processing and food products developments:** Food preservation, food irradiation, fermentation/processing of dairy foods, confectionary foods, cereals and grains, beverages special infant foods and formulas, Microorganisms in food, food packaging.
- 7. Quality assurance of nutraceuticals, dietary supplements & herbal products:** GMPs, hazard and risk analysis, quality factors, toxicity analysis, shelf life of nutraceuticals, functional foods and dietary supplements, Bioavailability and safety issues of functional foods and nutraceuticals.
- 8. Food Biotechnology:** Genetic engineering, improving plant and animal products, improving food processing.

Recommended Books:

1. Shils, ME, Olson, JA, Shike, M. Modern Nutrition in Health & Disease. Lea & Febiger.
2. Schulz, V., Hansel, R., Tyler, V. Rational Phytotherapy. A Physicians Guide to Herbal Medicine. Springer-Verlag Berlin Heidelberg New York.
3. Labuza, T.P. Functional Foods & Dietary Supplements

Third Year Second Semester

Curriculum Structure

Course No.	Course Title	Credit Hours
PHARM-311	Pharmaceutical Analysis-II	3
PHARM-312	Pharmaceutical Analysis-II-Lab	1
PHARM-313	Pharmaceutical Technology-II	3
PHARM-314	Pharmaceutical Technology-III-Lab	1
PHARM-315	Pharmacology-III	3
PHARM-316	Pharmacology-III-Lab	1
PHARM-317	Medicinal Chemistry-II	3
PHARM-318	Medicinal Chemistry-II-Lab	1
PHARM-319	Hospital & Community Pharmacy	3
VV-311	Viva-voce	1
	Total Credit Hours	20

Course Profile:

Course Title: Pharmaceutical Analysis-II

Course No: PHARM-311 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Chromatographic methods.		
	2. High performance liquid chromatography.		
	3. Gas chromatography.		
	4. Visible and ultraviolet spectrophotometry.		
	5. Fluorometry.		

	6. Potentiometric titration.		
	7. Polarography and amperometric titration.		

PHARM-311

Pharmaceutical Analysis-II

Credit Hr: 3

1. Chromatographic methods: Column chromatography and gel filtration techniques, thin layer chromatography, Ion exchange chromatography: Introduction, principles and theories, preparation, procedure, method of detection, applications.

2. High performance liquid chromatography: Introduction and theoretical principles, instrumentation, characteristics of stationary and mobile phases, reversed phase high performance liquid chromatography, applications, UFLC.

3. Gas chromatography: Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.

4. Visible and ultraviolet spectrophotometry: Introduction, electromagnetic radiation, units, electromagnetic spectra and absorption of radiation, chromophores and auxochromes, Lambert's and Beer's law, deviations from Lambert-Beer law, instrumentation, colorimetry, analysis of mixtures, absorption and intensity shifts, applications of Ultraviolet and visible spectroscopy in quantitative analysis of drugs.

5. Fluorometry: Introduction, theoretical principle, fluorescence and chemical structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and spectrophotometry, applications of fluorometry in pharmaceutical analysis.

6. Potentiometric titration: Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, applications of potentiometric titration.

7. Polarography and amperometric titration: Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.

Course Profile:

Course Title: Pharmaceutical Analysis-II Lab

Course No: PHARM-312

Credit Hour: 1 Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Estimation of ferrous fumarate from iron capsule.		
	2.Determination of ampicillin by iodometric titration.		
	3.Determination of potency of atenolol in the tablet by volumetric and conductometric method.		
	4. Determination of potency of captopril in tablets by volumetric and conductometric method.		
	5. Compare the titration curves using conductometric method when (a) 0.05 M solution of HCl (b) 0.05M solution of oxalic acid (c) 0.05M solution of acetic acid and (d) 0.05 M solution of acetyl salicylic acid are conductometrically determined with a		

	standard solution of sodium hydroxide.		
	6. Potentiometric determination of the concentrations of an iodide and a chloride sample in a mixture.		
	7. Determination of potency of paracetamol by UV-Visible spectrophotometric method.		
	8. Determination of potency of Diclofenac Sodium by UV-Visible spectrophotometric method.		
	9. Analysis of plant extract by thin layer chromatography(TLC).		

1. Estimation of ferrous fumarate from iron capsule.
2. Determination of ampicillin by iodometric titration.
3. Determination of potency of atenolol in the tablet by volumetric and conductometric method.
4. Determination of potency of captopril in tablets by volumetric and conductometric method.
5. Compare the titration curves using conductometric method when (a) 0.05 **M** solution of HCl (b) 0.05M solution of oxalic acid (c) 0.05M solution of acetic acid and (d) 0.05 M solution of acetyl salicylic acid are conductometrically determined with a standard solution of sodium hydroxide.
6. Potentiometric determination of the concentrations of an iodide and a chloride sample in a mixture.
7. Determination of potency of paracetamol by UV-Visible spectrophotometric method.

8. Determination of potency of Diclofenac Sodium by UV-Visible spectrophotometric method.
9. Analysis of plant extract by thin layer chromatography(TLC).

Books Recommended:

1. A Textbook of Pharmaceutical Analysis- Kenneth A. Connors, John Wiley & Sons.
2. Pharmaceutical Chemistry- Lasie G. Chatten, Marcel Dekker Inc.
3. A Textbook of Quantitative Inorganic Analysis, Vol. I & ~~11~~- Aurther **1**. Vogel, Long man, England.
4. United State Pharmacopoeia, United States Pharmacopoeia Convention, Inc.
5. British Pharmacopoeia.
6. Quality Control in Pharmaceutical Industry- Murray S. Cooper, Academic Press.
7. Organic Spectroscopy- Philip Crews, Jamie Rodriguez & Marcel Jaspurs, Oxford University Press, New York, London.
8. Practical Pharmaceutical Chemistry, Parts I and 2, By A. H. Backett & J. B. Stenlake, Athlone Press, London.
9. Introduction to Organic Laboratory Techniques- A Contemporary approach, D. L~ Pavia, G. M. Lampman, G. S. Krij, W. B. Saunders Company, Philadelphia, London, Torento.

Course Profile:

Course Title: Pharmaceutical Technology-III

Course No: PHARM-313

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Compaction and compression of powder.		
	2. Sustained release drug delivery systems.		
	3. Aerosol science and technology.		
	4. Design and operation of clean rooms.		
	5. Parenteral products.		
	6. Ophthalmic products.		
	7. Packaging technology.		

1. Compaction and compression of powder: Physics of tablet compression, mechanism of

tablet, bonding tablets, the effect of compressional force on tablet properties, effect of lubricants on tablet compression and binding, instrumented tablet machines and tooling, problems associated with large scale manufacturing of tablets.

2. Sustained release drug delivery systems: Principle of SR dosage forms, advantages and limitations of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, drug release mechanisms from SR dosage forms, formulation and manufacturing of SR matrix tablets, dose calculation for SR dosage forms, evaluation of sustained release dosage forms.

3. Aerosol science and technology: Definition and classification of aerosol, propellants for aerosol manufacturing, components of aerosol formulations, containers and valves for aerosols, metered dose delivery of aerosols, manufacturing of aerosols, testing and quality assurance of aerosols, packaging of aerosols.

4. Design and operation of clean rooms: Source of contamination, classification of clean rooms, airflow systems- conventional flow, unidirectional flow, laminar airflow 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 room;', routine monitoring tests, operation of clean and aseptic rooms, key factors in clean room operations.

5. Parenteral products: Definition and classification of parenteral products, formulation considerations, vehicles and additives, containers, manufacturing techniques, raw materials and machines, quality control of parenteral products, packaging of parenteral products.

6. Ophthalmic products: Anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, safety considerations of ophthalmic products, formulation, vehicles and additives, manufacturing considerations, environment, manufacturing techniques, quality control of ophthalmic products, packaging of ophthalmic products.

7. 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, labeling.

Course Profile:

Course Title: Pharmaceutical Technology-III Lab

Course No: PHARM-314

Credit Hour: 1 Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Formulation and preparation of Paracetamol Tablet.		
	2. Formulation and preparation of Cotrimoxazole suspension.		
	3. Formulation and preparation of Whitfield's Ointment.		
	4. Preparation of Chloramphenicol eye drop and checking their sterility.		
	5. Packaging study of different marketed dosage form.		
	6. Leak tests of packaging of tablet/capsule.		
	7. Accelerated stability testing of formulated dosage form.		

1. Formulation and preparation of Paracetamol Tablet.
2. Formulation and preparation of Cotrimoxazole suspension.
3. Formulation and preparation of Whit-field's Ointment.
4. Preparation of Chloramphenicol eye drop and checking their sterility.
5. Packaging study of different marketed dosage form.
6. Leak tests of packaging of tablet/capsule.
7. Accelerated stability testing of formulated dosage form.

Books recommended:

1. The Theory and Practice of Industrial Pharmacy by Lachman.
2. American Pharmacy by Sprowl.
3. Pharmaceutics by Aulton.
4. Remington's The science and practice of pharmacy
5. Dispensing of medication by Husa and Martin.
6. Pharmaceutical Practice by Aulton.
7. An Introductory to Pharmaceutical Formulations by Fishburn.
8. An introduction of Pharmaceutical Productions by Fishburn.
9. The Extra Pharmacopeia by Martindale.
10. British Pharmacopoeia
11. United States Pharmacopeia.

Course Profile:

Course Title: Pharmacology-III

Course No: PHARM-315

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Anti-diabetic drugs.		
	2. Drugs used in the treatment of neoplastic diseases.		
	3. Drugs used in cardiovascular disorders.		
	4. Endocrine pharmacology.		

1. Anti-diabetic 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 following individual- class of drugs:

d) Oral hypoglycemic agents:

i. Sulfonylureas,

ii. Biguanides

iii. Hormone preparations: Insulin

e) Management of diabetes mellitus

2. Drugs used in the treatment of neoplastic diseases:

a) Alkylating agents: Busulfan, mechlorethamine, uracil mustard and other agents,

- b) Antimetabolites: Folic acid analogs, pyrimidine and purine analogs
- c) Natural Products: Vinca alkaloids
- d) Antibiotics: Dactinomycin, Doxorubicin, Daunorubicin, Bleomycin etc.
- e) Enzymes
- f) Miscellaneous agents: Cisplatin, radioisotopes, gold preparations hormones etc.

3. Drugs used in cardiovascular disorders: Functions and disease of the heart, introduction, classification, chemistry, mode of action, structure activity relationship (SAR), pharmacokinetics, indication, and contraindications, dose, adverse effects and drug interaction of individual class of following drugs:

- a) Cardiac glycosides
- b) Anti arrhythmic drugs
- c) Anti-hypertensive drugs: p-blockers, vasodilators, Ca-channel blocking agents and ACE inhibitors.
- d) Anticoagulants and antiplatelet agents.
- e) Diuretics

4. Endocrine pharmacology:

- a) Overview of endocrine glands
- b) Pituitary hormones- growth hormone, prolactin, oxytocin, vasopressin etc.
- c) Thyroid hormones- drugs used in hyperthyroidism and hypothyroidism
- d) Adrenal steroids
- e) Contraceptives.

Course Profile:**Course Title: Pharmacology-III Lab****Course No: PHARM-316****Credit Hour: 1 Contact Hours: 1****Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	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 Biuret method.		
	5. Estimation of blood uric acid level by enzymatic method.		

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 Biuret method.
5. Estimation of blood uric acid level by enzymatic method.

Books Recommended:

1. Goodman & Gillman's Pharmacological Basis of Therapeutics- Hardman, Joel G., McGraw Hill Incorporated.
2. Basic and Clinical Pharmacology- Bertram G. Katzung, Me Graw Hill Companies.
3. Medical Pharmacology-Andres Goth, Toppan Co. Ltd.
4. Pharmacology & Pharmacotherapeutics- R. S. Satosker, Popular Prakashani Ltd. India.

5. Clinical Pharmacology- D, R. Laurence, P. N. Bennett and M. J. Brown, Churchill Living stone.
6. Clinical Pharmacy and Therapeutics, Roger walker and Clive Edwards, Churchill Living stone.

Course Profile:

Course Title: Medicinal Chemistry-II

Course No: PHARM-317 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Drug discovery and design		
	2. Chemistry, mode of action, SAR, synthesis, biochemical approaches to drug design (where applicable) and physico-chemical properties of following groups of drugs		
	(a) Psychotropic drugs and antidepressants,		
	(b) Antidiabetic drugs,		
	(c) Semisynthetic penicillin's, cephalosporins, quinolone derivatives,		

	(d) Oral contraceptives and steroidal hormones.		
	3. Drugs metabolism.		

1. Drug discovery and design

- (a) Source of drugs
- (b) Cost and place of development of drugs
- (c) Search for new drugs
- (d) Genesis of drugs: i) Serendipity ii) Random screening iii) Extraction from natural sources iv) Molecular modification (general process, special process-ring closure or opening, formation of lower or higher homologues, introduction, removal or replacement of bulky groups, isosteric substitution, change of position or certain groups, introduction of alkylating moieties, modification towards inhibition or promotion of various electronic states). Methods of lead optimization (Topliss sequential method), Fibonacci Search, sequential complex optimization
- (v) Selection or synthesis of soft drugs, soft analogues, activated soft compounds, natural soft drugs, soft drugs based on the active metabolite approach, soft drug based on inactive metabolite approach (vi) Pro-drugs.

2. Chemistry, mode of action, SAR, synthesis, biochemical approaches to drug design (where applicable) and physico-chemical properties of following groups of drugs:

- (a) Psychotropic drugs and antidepressants,
- (b) Antidiabetic drugs,
- (c) Semisynthetic penicillin's, cephalosporins, quinolone derivatives,
- (d) Oral contraceptives and steroidal hormones.

3. Drugs metabolism: Pathways of drugs metabolism, metabolism of various groups of drugs; Factors affecting drug metabolism, methods of studying drug metabolism, new aspects of drug metabolism; Metabolic products of common drugs.

Course Profile:

Course Title: Medicinal Chemistry-II Lab

Course No: PHARM-318

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Synthesis and identification of Acetanilide in laboratory.		
	2. Synthesis and identification of Para amino phenol in laboratory.		
	3. Synthesis and identification of N-acetyl cysteine in laboratory.		
	4. Synthesis and identification of Meta nitro benzaldehyde in laboratory.		
	5. Synthesis and identification of Ethyl para hydroxyl benzoate in laboratory.		

1. Synthesis and identification of Acetanilide in laboratory.
2. Synthesis and identification of Para amino phenol in laboratory.
3. Synthesis and identification of N-acetyl cysteine in laboratory.
4. Synthesis and identification of Meta nitro benzaldehyde in laboratory.
5. Synthesis and identification of Ethyl para hydroxyl benzoate in laboratory.

Books Recommended

1. Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry-Jaime N. Delgado & William A. Remers, LippincottRaven, Philadelphia Newyork.
2. Burger's Medicinal Chemistry and Drug Discovery- Donald J. Abraham, John Wiley and Sons.
3. Essentials of Medicinal chemistry- Andrejus Korolkovas, John Wiley and Sons.
4. Heterocyclic Chemistry- J. A. Joule and G. F. Smith, English Language book Society.
5. Foye's Principles of Medicinal Chemistry- David A. Williams and Thomas L. Lemke, Lippincott Williams & Wilkins.
6. Medicinal Chemistry: Principles and Practice- Frank D. King, The Royal Society of Chemistry.
7. An Introduction to Medicinal Chemistry- Graham L. Patrick, Oxford University Press.

Course Profile:

Course Title: Hospital & Community Pharmacy

Course No: PHARM-319

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	A. Hospital Pharmacy.		
	1. Introduction.		
	2. Pharmacy and therapeutics committee.		
	3. Purchasing and inventory control.		
	4. Control of special classes of drugs.		
	5. Dispensing to In- and out-patients.		
	6. Manufacturing- bulk and sterile.		
	B. Community pharmacy.		
	C. Rational use of drugs.		
	D. Forensic pharmacy.		
	E. Drug abuse.		

A. Hospital Pharmacy

1. 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 description.

2. 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.

3. Purchasing and inventory control: Purchasing agent, purchasing procedure, control on purchase, storage, perishable inventory, physical inventory, perpetual inventory.

4. Control of special classes of drugs: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols, narcotics and their control, classes, procurement and execution of "order forms, dispensing, hospital narcotic regulations, new systems, (floor stock drugs, selection, charge" and "non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.

5. 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.

6. Manufacturing-bulk and sterile: Control and budget, manufacturing facility and capacity, operating costs, quality control.

B. Community pharmacy: Concepts of community pharmacy, health needs of the community, different levels of health care, Non-govt. health agencies.

C. Rational use of drugs: Background of RUD, definition, factors underlying irrational use of drugs; international network for RUD.

D. Forensic pharmacy: Definition, epidemiology of poisoning, role of pharmacists at different levels.

E. Drug abuse: Definition, patterns, epidemiology of drug abuse, diagnosis, treatment, prevention, role of pharmacist in drug abuse prevention.

Books recommended:

1. Hospital Pharmacy- William E. Hasan, Lea & Febiger, Philadelphia.
2. Textbook of Hospital Pharmacy- M. C. Allwood, J. T. Fell, Vt Blackwell Scientific Publications, Oxford

Course Profile:

Course Title: Viva-Voce

Course No: VV-311 Credit Hour: 1 Contact Hours: 1 Total Marks:

Rationale:

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Objectives:

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Curriculum Structure

Fourth Year First Semester		
Course No.	Course Title	Credit Hours
PHARM-401	Pharmaceutical Analysis-III	3
PHARM-402	Pharmaceutical Analysis-III-Lab	1
PHARM-403	Medicinal Chemistry-III	1.5
PHARM-404	Cosmetology	3
PHARM-405	Cosmetology-Lab	1
PHARM-406	Biopharmaceutics-I	3
PHARM-407	Biopharmaceutics-I-Lab	1
PHARM-408	Pharmaceutical Engineering	3
PHARM-409	Clinical Pharmacy	3
	Total Credit Hours	19.5

Course Profile:

Course Title: Pharmaceutical Analysis-III

Course No: PHARM-401 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Ultra violet and infrared spectrophotometry in structural analysis.		
	2. Infra-red spectrophotometry.		
	3. Nuclear magnetic resonance spectroscopy.		
	4. ¹³C NMR spectroscopy.		
	5. Mass spectrometry.		
	6. Atomic absorption		

	spectroscopy		
	7. Microbiological assay of antibiotics		

1.Ultra violet and infrared spectrophotometry in structural analysis.

2.Infra-red spectrophotometry: Principles, instrumentation, sampling techniques, recording of IR spectra of correlation table/chart in structural analysis, qualitative and quantitative applications.

3.Nuclear magnetic resonance spectroscopy: ^1H NMR spectroscopy: Introduction and theory, relaxation process, instrumentation, chemical shift, factors affecting chemical shifts spin-spin coupling, factors affecting coupling constants, different spin systems, coupling constants, spin-spin decoupling, long range coupling; Two dimensional NMR spectroscopy, nuclear over hauser effect (noe), 2D correlated (COSY) and 2D nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC.

4. ^{13}C NMR spectroscopy: Introduction, principle, chemical shift, spin-spin coupling, DEFT, applications of ^{13}C NMR spectroscopy.

5.Mass spectrometry: Introduction, theory, mass spectrum, ionization techniques, (EI, CI, **FAB**, MALDI etc.) recognition of molecular ion, determination of molecular formula fragmentation process, application.

6.Atomic absorption spectroscopy: Theory, instrumentation and application in quantitative analysis.

7.Microbiological assay of antibiotics: Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors affecting diffusion assay, dose response curve, large plate assay using Latin square design, statistical interpretation of microbiological assay methods.

Course Profile:

Course Title: Pharmaceutical Analysis-III Lab

Course No: PHARM-402

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Estimation of potency of different API by UV spectroscopic method.		
	2. Estimation of potency of different market preparations by UV spectroscopic method.		
	3. Determination of molecular formula of different chemical compounds by NMR, IR and Mass spectroscopic data.		
	4. Determine the potency of marketed amoxicilline capsule by		

	tube dilution method.		
	5. Determine the potency of marketed ampicilline capsule by disk diffusion method.		

1. Estimation of potency of different API by UV spectroscopic method.
2. Estimation of potency of different market preparations by UV spectroscopic method.
3. Determination of molecular formula of different chemical compounds by NMR, IR and Mass spectroscopic data.
4. Determine the potency of marketed amoxicilline capsule by tube dilution method.
5. Determine the potency of marketed ampicilline capsule by disk diffusion method.

Books Recommended:

1. Organic Structure for Spectra- L. D. Field, S. Sternhell, J. R. Kalman, John Willey & Sons, New York, Singapore.
 2. Introduction to Spectroscopy- Donald L. Pavia., Gary M. Lampman, George S. Kriz, Books/ Cole, Thomson Learning. Dudley H. Williams, Ian
 3. Spectroscopic Methods in Organic Chemistry, Flemming, Tata McGraw-Hill Publishing Company Limited.
 4. Interpretation of NMR Spectra: An Empirical Approach, Roy H. Bible, Plenum Press, New York,
 5. One and Two Dimensional NMR Spectroscopy - Alta-UV Rahman, Elsevier.
 6. Introduction to Mass Spectrometry, H.C.Hill, Heyden & Son Limited.
- Interpretation of Mass Spectra, Fred W. McLafferty, W.A Benjamin Inc., New York.

Course Profile:

Course Title: Medicinal Chemistry-III

Course No: PHARM-403

Credit Hour: 1.5

Contact Hours: 1.5

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Combinatorial chemistry.		
	2. Chemistry, mode of action, SAR, synthesis, biochemical approaches to drug design (where applicable), physico-chemical properties of following groups of drugs		
	(a) Cholinergic drugs		
	(b) Anti-Cholinergic drugs		
	(c) Adrenergic drugs		
	(d) Anticancer drugs		
	3. Toxicity studies of drugs.		
	4. Novel drug discovery.		
	5. Synthesis and characterization of the following active		

	pharmaceutical ingredients (API):		
	a) Paracetamol		
	b) Aspirin		
	c) Diazepam		
	d) Ranitidine		
	e) Tolbutamide		

1. Combinatorial chemistry: (a) Combinatorial synthesis: Introduction to drug discovery process (b) Library synthesis on resin beads - solid phase chemistry, resin beads, speeding up of peptide synthesis, mix and split library synthesis (c) Solution phase combinatorial synthesis, d) Encoded combinatorial synthesis-encoded requirements. Examples of tagged libraries e) Solid phase library, chemistry of linkers, carboxylic acid linkers, carboxamide linkers, alcohol linkers, amine linkers, traceless linkers, light cleavable linkers, selected solid phase chemistry, f) Combinatorial chemistry: applications and impact on drug discovery.

2. Chemistry, mode of action, SAR, synthesis, biochemical approaches to drug design (where applicable), physico-chemical properties of following groups of drugs:

- (a) Cholinergic drugs
- (b) Anti-Cholinergic drugs
- (c) Adrenergic drugs
- (d) Anticancer drugs

3. Toxicity studies of drugs: New drug discovery via observation of side effects and drug metabolism study.

4. Novel drug discovery: Screening of drug from natural products, scientific aspects of drug discovery, rational drugs design, antimetabolites, enzyme inhibitors, methods of lead optimization (targeted high throughput screening),

5. Synthesis and characterization of the following active pharmaceutical ingredients (API):

- a) Paracetamol
- b) Aspirin
- c) Diazepam
- d) Ranitidine
- e) Tolbutamide

Books Recommended:

1. Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry-Jaime N. Delgado & William A. Remers, Lippincott Raven, Philadelphia Newyork.
2. Burger's Medicinal Chemistry and Drug Discover)'- Donald.J.Abraham, John Wiley and Sons.
3. Essentials of Medicinal chemistry- Andrejus Korolkovas, John Wiley and Sons.
4. Heterocyclic Chemistry- J. A. Joule and G. F. Smith, English Language book Society.

5. Foye's Principles of Medicinal Chemistry- David A. Williams and Thomas L. Lemke, Lippincott Williams & Wilkins.
6. Medicinal Chemistry: Principles and Practice- Frank D. King, The Royal Society of Chemistry.
7. An Introduction to Medicinal Chemistry- Graham L. Patrick, Oxford University Press.

Course Profile:

Course Title: Cosmetology

Course No: PHARM-404

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. The skin.		
	2. Product ingredients.		
	3. The manufacture of cosmetics.		
	4. Skin creams.		
	5. Shaving preparations.		
	6. Dental products.		
	7. Hair products.		

1. The skin: Introduction, epidermis and keratinizing system, pigment 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. Product ingredients: Commonly used surface-active agents, humectants, antiseptics, preservatives, antioxidants'.

3. The manufacture of cosmetics: Introduction, mixing and the manufacture of bulk cosmetic products, solid-solid mixing, manufacture of pigmented powder products, mixing processes involving fluids,

general principles of fluid mixing, mixing equipments for fluids, solid-liquid mixing, suspension of solids in agitated tanks, liquid-liquid mixing- miscible liquid, immiscible liquid.

4. Skin creams: Introduction, Classification of skin creams, cold creams, cleansing creams, night and massage creams, moisturizing, vanishing and foundation creams, pigmented foundation creams, hand creams and hand-and-body creams, all purpose creams.

5. Shaving preparations: Introduction, Lather shaving cream, brush less or non-lathering cream, aerosol shaving foams, after-shave preparations.

6. Dental products: Introduction, formulation and manufacturing of toothpastes and tooth powders, mouthwash.

7. Hair products: Introduction, shampoos, hair setting lotions, hair tonics and conditioners.

Course Profile:

Course Title: Cosmetology Lab

Course No: PHARM-405

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Formulation and preparation of cold cream.		
	2. Formulation and preparation of vanishing cream.		
	3. Formulation and preparation of transparent shampoo.		
	4. Formulation and preparation of Egg shampoo.		
	5. Formulation and preparation of talcum powder.		
	6. Formulation and preparation of tooth powder.		
	7. Formulation and preparation of after shave lotion.		
	8. Formulation and preparation of shaving cream.		

1. Formulation and preparation of cold cream.
2. Formulation and preparation of vanishing cream.
3. Formulation and preparation of transparent shampoo.
4. Formulation and preparation of Egg shampoo.
5. Formulation and preparation of talcum powder.
6. Formulation and preparation of tooth powder.
7. Formulation and preparation of after shave lotion.
8. Formulation and preparation of shaving cream.

Books Recommended:

1. Chemistry and Technology of the Cosmetics and Toiletries Industry- D. F., Williams and W. H. Schmitt, Hardcover, Kluwer Academic Publications.
2. Harry's Cosmetology- J. B. Wilkinson & R. J. Moore, Longman.
3. Modern Cosmetics~ Perfumes, Cosmetics and Soaps, Vol. I, II and III- W. A. Poucher, Chapman & Hall, London.

Course Profile:

Course Title: Biopharmaceutics and Pharmacokinetics-I

Course No: PHARM-406

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction of pharmaceutics and biopharmaceutics.		
	2. Gastrointestinal absorption of drugs.		
	(a) Biological consideration.		
	(b) Physicochemical consideration.		
	(c) Dosage form consideration.		
	(d) Disintegration and dissolution of drugs.		
	3. Distribution of drugs.		
	4. Drug clearance.		
	(a) Theoretical aspects of drug elimination, excretion and biotransformation.		
	(b) Interpretation of Drug-Plasma Level Curve.		
	(c) Hepatic		

	elimination.		
	(d) Billiary excretion of drugs.		
	5. Bioavailability and bioequivalence.		
	6. Drug product selection on the basis of bioavailability testing.		

1. Introduction of pharmaceutics and biopharmaceutics

2. Gastrointestinal absorption of drugs:

- (a) **Biological consideration:** Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.
- (b) **Physicochemical consideration:** pK_a and gastrointestinal absorption, p^H -partition theory and other physiochemical factors.
- (c) **Dosage form consideration:** Role of different dosage form like solution, suspension, tablet, capsule, emulsion etc. on gastrointestinal absorption.
- (d) **Disintegration and dissolution of drugs.**

3. Distribution of drugs:

- (a) Important Pharmacokinetic parameters such as biological half-life, apparent volume of distribution, area under the curve, elimination rate constant etc.
- (b) Interpretation of Drug-Plasma Level Curve.
- (c) **Drug-protein interaction:** Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of binding sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.

4. Drug clearance:

- (a) Theoretical aspects of drug elimination, excretion and biotransformation.
- (b) Renal elimination: Glomerular filtration, Active tubular secretion, Tubular re-absorption, determination of renal clearance.
- (c) Hepatic elimination: Biotransformation of drugs, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michaelis-Menten Equation), First pass effect, Liver excretion ratio, Relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, Hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance).
- (d) Billiary excretion of drugs.

5. 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.

6. Drug product selection on the basis of bioavailability testing.

Course Profile:

Course Title: Biopharmaceutics and Pharmacokinetics-I Lab

Course No: PHARM-407

Credit Hour: 1 **Contact Hours:** 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Determination of binding sites and association constant.		
	2. Estimation of aspirin after oral administration by UV spectrophotometric method.		
	3. Estimation of aspirin after oral administration by colorimetric method.		
	4. Estimation of paracetamol after oral administration by UV/Visible spectrophotometric method.		
	5. Estimation of Ciprofloxacin-SRDF after oral administration by UV spectrophotometry method.		

1. Determination of binding sites and association constant.
2. Estimation of aspirin after oral administration by UV spectrophotometric method.
3. Estimation of aspirin after oral administration by colorimetric method.
4. Estimation of paracetamol after oral administration by UV/Visible spectrophotometric method.
5. Estimation of Ciprofloxacin-SRDF after oral administration by UV spectrophotometry method.

Books Recommended:

1. Biopharmaceutics & Clinical Pharmacokinetics - Milo Gibaldi, Le & Febiger, Philadelphia.
2. Applied Biopharmaceutics and Pharmacokinetics - Leon Shargel & Andrew Yu
3. Biopharmaceutics & Clinical Pharmacokinetics- Notari, R. E., Marcel Dekker Inc.
4. Biopharmaceutics & Relevant Pharmacokinetics- T. G. Wagner and M. Pernarowski, Hamilton Drug, Intelligence Publication.
5. Biopharmaceutics & Drug Interactions- Donald E. Cadwallar, Raven Press, Newyork.
6. Pharmacokinetics- M. Gibaldi & D. Perrier.

Course Profile:

Course Title: Pharmaceutical Engineering

Course No: PHARM-408

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. The fundamentals of unit operations.		
	2. Drying.		
	3. Filtration.		
	4. Centrifugation.		
	5. Mixing		
	a. Solid-solid mixing.		
	b. Paste mixing.		
	c. Liquid mixing.		
	6. Water purification engineering.		
	7. Lay out plan of pharmaceutical manufacturing plant.		
	8. Other techniques.		

1. The fundamentals of unit operations,

(a) fluidflow (b) heat transfer and (c) mass transfer

2.Drying:Definition, importance of drying, terminology, theory and fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content, equilibrium moisture content.

Classification, direct, indirect radiation, batch and continuous, dielectric, types of beds static, moving, fluidized, pneumatic bed systems, different drying equipments, construction, operation, merit & demerits, tray dryer, through-circulation dryer, pneumatic conveying, rotary dryer, spray dryer, tunnel dryer, steam tube rotary dryer, agitated pan dryer, vacuum rotary dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection.

Freeze drying: Definition, application, basic principles, basic elements.

3. Filtration: Definition, importance of filtration, difference with expression, sedimentation and drying, classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment, construction, operation, merits, demerits, the gravity nutsche, delpark industrial filter, bag fillers, sand filters, plate and frame press, recessed plate filter press, eimco-burwell plates and frames, readco short cycle filter, vertical **pressure** leaf filter, horizontal plate filter, industrial tubular filter, Rodney hunt pressure filter, moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipments.

4. Centrifugation: General principles, Magnitude of centrifugal force, materials of construction, critical speed, sedimentation centrifuges, filtering centrifugals, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, costs, selection of centrifugal separators.

5. Mixing:

a. Solid-solid mixing: Importance, fundamentals, batch homogeneity, types of solids-mixing machines, mixing mechanisms and operations, double cone, twin shell, horizontal drum, double-cone revolving around hag; axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor', performance characteristics, selection of machines.

b. Paste mixing: Definition, importance, simple blending, dispersion operations, 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, selections of process and mixer.

c. Liquid mixing: Definition, importance, mixing equipment axial end radial flow, Impellers, mechanisms, flow patterns, impellers, flat-blade and curves-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, costs, selection of impeller.

6. Water purification engineering: Types of water, Impurities in water, water softening and purification for potable water, Production and generation of Purified water (PW), Production of Water for injection (WFI), Techniques used in water purification, such as, deionization, electro deionization (EDI), distillation, reverse osmosis. Water storage and distribution systems for pharmaceutical plant, loop system. Piping components and types.

7. Lay out plan of pharmaceutical manufacturing plant: Guidelines for selecting new plant sites, pharmaceutical lay out plan and design, criteria for production facilities. Fundamentals of pharmaceutical HVAC systems.

8. Other techniques: Cooling and refrigeration, dehumidification and dehumidifiers, size reduction and classification, evaporation and distillation.

Books Recommended:

1. Coulson and Richardson's Chemical Engineering- J. F. Richardson and J.M. Coulron and R. K. Sinott, -)Butterworth- Heinemann.
2. Introduction to Chemical Engineering- Walter L. Badger and J.T. Banch CFO, McGraw-Hill Education.
3. Perry's Handbook of Chemical Engineering- Robert H, Perry & Don W. Green, Mc Graw-Hill.
4. Chemical Engineering Techniques- Lauer & Heckmann.
5. Elementary Engineering Drawing- N. D. Bhatt and V. M. Panchal, Charotar Publisher.
6. An Introductory to Pharmaceutical Formulations by Fishburn.
7. An introduction of Pharmaceutical Productions by Fishburn.
8. The Theory and Practice of Industrial Pharmacy by Lachman.
9. American Pharmacy by Sprowl.
10. Pharmaceutical Practice by Aulton.
11. The Extra Pharmacopeia by Martindale.
12. Remington's Pharmaceutical Sciences.

Course Profile:

Course Title: Clinical Pharmacy

Course No: PHARM-409

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. General consideration.		
	2. Guidance for special clinical practices.		
	3. Clinical pharmacy for OTC preparations.		
	4. Clinical toxicology.		
	5. Clinical signs, symptoms and management of poisoning.		

- 1. General consideration:** Scope, importance and application of clinical pharmacy, clinical hematology, blood bank techniques etc organ function tests, clinical pathology/ manifestation of diseases/drug or hospital acquired diseases, cautionary and advisory notes for drug therapy.
- 2. Guidance for special clinical practices:** Neonates, children, elderly, terminal care, liver disease, renal impairment, pregnancy and lactating mothers.
- 3. Clinical pharmacy for OTC preparations:** Antacids and anti-flatulence, antidiarrhoeals, laxatives, emetics and antiemetics, antihistamines and anti-allergen, analgesics, contraceptives, Ear-nose-throat preparations, dermatological preparations.

4. **Clinical toxicology:** Role of poison centers, adverse reactions and poisoning incidences, analysis of poisoning situations, poison information sources, assessment of poison exposure.
5. **Clinical signs, symptoms and management of poisoning:** Case with pesticides, fumigants, solvents, vapors, gases, food toxins, cyanides poison, cosmetics, toxins of animal origin, over-doses of drugs, drug interactions etc.

Books recommended:

1. Principle of Clinical Pharmacology- Atkinson.
2. Workbook for Clinical Pharmacy and Therapeutics- Hart.
3. Handbook of Clinical Research- Lloyd.
4. Clinical Pharmacy and Therapeutics- Walker.
5. **Clinical Pharmacy & Therapeutics- Herfindal.**

Fourth Year Second Semester

Curriculum Structure

Fourth Year Second Semester		
PHARM-411	Pharmaceutical Biotechnology	Credit Hr: 3
PHARM-412	Advance Pharmacology and Toxicology	Credit Hr: 3
PHARM-413	Biopharmaceutics-11	Credit Hr: 3
PHARM-414	Biopharmaceutics-11-Lab	Credit Hr: 1
PHARM-415	Pharmaceutical Quality Control and Analytical Method Validation	Credit Hr: 3
PHARM-416	Pharmaceutical Quality Control and Analytical Method Validation - Lab	Credit! Hr:1
PHARM-417	Pharmaceutical Marketing & Management	Credit Hr: 3
PHARM-418	Pharmaceutical Regulatory Affairs	Credit Hn 3
PHARM-419	Project	Credit Hr: 3
PHARM-420	In-Plant Training	Credit Hr: 1.5
VV-411	Viva-Voce	Credit Hr; 1
	Total Credit Hours	25.5

Course Profile:

Course Title: Pharmaceutical Biotechnology

Course No: PHARM-411 Credit Hour: 3 Contact Hours: 3 Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction.		
	2. Immobilization of enzyme.		
	3. Fermentation Technology.		
	4. Recombinant DNA Technology.		
	5. Basic Immunology.		
	6. Antisense therapy.		
	7. Bioinformatics.		

	8. Dispensing Biotechnological Products.		
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1. Introduction: Pharmacists and biotechnology, approved biotechnological products and vaccines, GMP compliance of biopharmaceutical facilities, scopes of biotech products in Bangladesh.

2. Immobilization of enzyme: Surface immobilization by covalent coupling, Adsorption, Complexation and chelation, within support immobilization and cell immobilization.

3. Fermentation technology: Fermentation process and optimization, improvement of microbial strains, structure and types of fermenter, fermented pharmaceutical products (Antibiotics and Vitamins).

4. Recombinant DNA Technology: Introduction, cutting and rejoining of DNA, Mutagenesis, Polymerase Chain Reaction (PCR) in gene amplification, pharmaceutical application of recombinant DNA technology, drug delivery system, gene therapy, basic molecular mechanism of gene transfer, pre requisite of human gene therapy, gene therapy for cancer and HIV patients, various problems in gene therapy.

5. Basic immunology: Natural and acquired immunity, innate immune system, adapted, acquired immunity, specific immunity and antibody clonal selection. Cells of immune system, antibody and immunoglobulin, monoclonal antibody and its application, current trends in vaccines, delivery considerations of biopharmaceutical products, basic principles of immunological drug products.

6. Antisense therapy: Antisense therapy, basic concept, mechanism of antisense therapy and examples of antisense therapy for the treatment of different diseases.

7. Bioinformatics: Definition and concepts, importance of bioinformatics, biological database, primary sequence database, protein sequence database, DNA sequence database, genome resource web addresses, multiple sequence alignment, importance of multiple sequence alignment for drug design, importance of coiled coil peptide for drug design.

8. Dispensing Biotechnological products: Storage and maintenance, handling and transportation requirements, preparation and administration, reimbursement.

Book Recommended

1. Biotechnology and its application in Pharmacy -Giriraj Kulkarni.
2. Pharmaceutical Biotechnology- Vyas & Dixit
3. Pharmaceutical Biotechnology- Crommclin

Course Profile:

Course Title: Advance Pharmacology and Toxicology

Course No: PHARM-412

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	A. Pharmacology		
	i. Antibacterial drugs.		
	ii. Anti-mycobacterial agent		
	iii. Antiprotozoal drugs.		
	iv. Antifungal drugs.		
	v. Antiviral drugs.		
	vi. Anthelmintic drugs.		
	2. Ophthalmology.		
	B. Toxicology.		
	1. Introduction.		
	2. Adverse reactions.		
	3. Drug abuse.		
	4. Poisoning.		
	5. Medicinal poisoning.		

	6. Animal and Plant poisoning.		
	7. Household & Industrial poisoning.		
	8. Arsenic Poisoning.		

A. Pharmacology:

1. Introduction, classification, chemistry, mode of action, SAR, pharmacokinetics, indication, and contraindications, dose, adverse effects and drug interaction of the following drugs:

- i. Antibacterial drugs: Sulphonamides, Beta-lactum antibiotics (Penicillin and Cephalosporins), Tetracyclines, Chloramphenicol, Aminoglycoside, Macrolides and Fluoroquinolones etc.
 - ii. Antimycobacterial agents: Rifampicin, isoniazid, ethambutol.
 - iii. Antiprotozoal drugs: Antimalarials, Antiamoebics etc.
 - iv. Antifungal drugs: Amphotericin B, griseofulvin, fluconazole, itraconazole, ketoconazole.
 - v. Antiviral drugs: Acyclovir, ritonavir, zidovudine, stavudine.
- Anthelmintic drugs; Mebendazole, albendazole, piperazine

2. **Ophthalmology**- Anatomical consideration, corneal grafting, cataract formation, contact lens, drugs used in the treatment of eye disorders.

B. Toxicology:

1. **Introduction:** Principles, terminology (LD_{50} , LD_{10} , ED_{50} , Therapeutic Index etc.), and evaluation of toxicology in animals.

2. **Adverse reactions:** Classification and causes of adverse reactions; factors affecting different adverse reactions:

- a. Drug induced hepatic dysfunction
- b. Drug induced endocrine dysfunction
- c. Drug induced neuromuscular and CNS dysfunctions.

3. **Drug abuse:** General considerations; characteristics and treatment of drug abuse; consequences of drug abuse, control of drug abuse etc.

4. **Poisoning:** Introduction, types of poisoning, factors affecting poisoning; interventions by pharmacists in the prevention, diagnosis, management of poisoning.

5. **Medicinal poisoning:** Poisoning due to common analgesics, tranquilizers, barbiturates, anticonvulsants, antidepressants, iron preparations, cardiotonics, alcohol etc.; antidotes for medicinal poisonings.

6. **Animal and plant poisoning:** Common causes of poisoning, (snake and insect bite, mushroom consumption etc.), antidotes.

7. Household & industrial poisoning: Common causes, exposure, control and preventive measures, antidotes.

8. Arsenic poisoning: Ground water and arsenic poisoning, geographical distribution of arsenic poisoning in Bangladesh, detection of arsenic in water; symptoms, diagnosis, prevention and treatment of arsenic poisoning; arsenic mitigation programs in Bangladesh.

Book Recommended

1. Goodman & Gillman's Pharmacological Basis of Therapeutics- Hardman, Joel G., McCraw Hill Incorporated.
2. Basic and Clinical Pharmacology- Bertram G. Katzung, Me Graw Hill Companies.
3. Medical Pharmacology-And res Goth, Toppan Co. Ltd.
4. Pharmacology & Pharmacotherapeutics- R. S. Satosker, Popular Prakashani Ltd. India.
5. Clinical Pharmacology- D, R. Laurence, P. N. Bennett and M. J. Brown, Churchill Living stone.
6. Clinical Pharmacy and Therapeutics, Roger walker and Clive Edwards, Church 11 Living stone.
7. The Toxicology Handbook for Clinicians - Harris C R
8. Loomi's Essential of Toxicology.
9. Meyler's Side Effects of Drugs - Aronson J K
10. British National Formulary BNF
11. Casarett & Doull's Toxicology - Klaassen C
12. Basic and Clinical Pharmacology - Katzung B G
13. Heavy Metals in the Environment: Origin, Interaction and Remediation Edited by Heike Bradl

Course Profile:

Course Title: Biopharmaceutics-II

Course No: PHARM-413

Credit Hour: 3 Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Introduction to compartment.		
	2. Pharmacokinetics of drug absorption.		
	3. Multiple dosage regimen (MDR).		
	4. Intravenous infusion.		
	5. Dosage adjustment in renal disease.		
	6. Dose adjustment in liver diseases.		
	7. Non-compartmental analysis.		
	8. Relationship between pharmacokinetic and pharmacologic responses.		

1. Introduction to compartment.

(a) One-compartment open model, determination of plasma concentration from one compartment open model, elimination rate constant, apparent volume of distribution, calculation of K from urinary data.

(b) Multiple compartment models:

(i) Two-compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant.

(ii) Three compartment open model, method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.

2. Pharmacokinetics of drug absorption: Zero-order absorption model, first-order absorption model, determination of absorption rates constant from oral absorption data.

3. Multiple dosage regimen (MDR): Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bioequivalence 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, dose adjustment based on the elimination rate constant, measurement of glomerular filtration rate (GFR), calculation of creatinine, clearance from serum creatinine concentration, dose adjustment based on nomogram, Giusti-Hayton method, Wagner method.

(b) Extracorporeal removal of drugs.

6. Dose adjustment in liver diseases:

Pharmacokinetic considerations, general approach for dose adjustment in liver disease, cholestasis and prediction of disease effects, disease effects of protein binding, clinical significance and pharmacokinetic implication.

7. Non-compartmental analysis: Physiologic-pharmacokinetic model, statistical moment, mean residence time etc.

8. Relationship between pharmacokinetic and pharmacologic responses.

Course Profile:

Course Title: Biopharmaceutics-II Lab

Course No: PHARM-414

Credit Hour: 1

Contact Hours: 1

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Determination of the dissolution time and dissolution rate of the enteric coated diclofenac sodium tablet.		
	2. In vitro dissolution study of theophylline tablet.		
	3. In vitro dissolution study of SRDF theophylline capsule.		

Books Recommended:

1. Biopharmaceutics & Clinical Pharmacokinetics - Milo Gibaldi, Le & Febiger, Philadelphia.
2. Applied Biopharmaceutics and Pharmacokinetics - Leon Shargel & Andrew Yu
3. Biopharmaceutics & Clinical Pharmacokinetics- Notari, R. E., Marcel Dekker Inc.
4. Biopharmaceutics & Relevant Pharmacokinetics- T. G. Wagner and M. Pernarowski, Hamilton Drug Intelligence Publication.
5. Biopharmaceutics & Drug Interactions- Donald E. Cadwallar, Raven Press, Newyork.
6. Pharmacokinetics- M. Gibaldi & D. Perrier.

Course Profile:

Course Title: Pharmaceutical quality control and analytical method validation

Course No: PHARM-415

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Quality control overview.		
	2. Terminology and validation overview.		
	3. Validation of analytical methods.		
	4. Overview of pharmaceutical product development and its associated quality system.		
	5. Potency method validation.		
	6. Validation of chromatographic methods.		
	7. Performance verification of UV-Visible spectrophotomet		

	ers.		
	8. Bioanalytical method validation.		
	9. Quality control of herbal drugs.		

1. Quality control overview: Introduction, preliminaries and definitions, quantitative and qualitative analysis (general information), significance of quantitative and qualitative analysis in quality control.

2. Terminology and validation overview: Introduction, preliminaries and definitions, survey of analytical methods, validation and statistical treatment of analytical data, required data for analytical procedure: Validation characteristics: accuracy /trueness, precision: repeatability (within-laboratory variation), intermediate precision, reproducibility, robustness, specificity, detection limit, quantitation limit, linearity, range. Terminologies used in the validation of analytical procedures

3. Validation of analytical methods: Strategy for the validation of methods, verification of standard methods, validation of non-routine methods, transferring validated routine methods, revalidation, parameters for method validation, data review and validation and evaluation of uncertainty, handling out-of-specification situations. Analytical validation within the pharmaceutical environment: regulatory requirements, integrated and continuous validation, general planning and design of validation studies, evaluation and acceptance criteria, and statistical tests. Validation standard operating procedures: fundamentals of validation sops, validation master plan and guideline for DQ, IQ, OQ, and PQ.

4. Overview of pharmaceutical product development and its associated quality system:

Discovery research, analytical development of API and drug products, impurities level in new drug product, formulation development, quality system for the analytical development laboratory, consideration for quality systems in development, GMPS applied to development.

5. Potency method validation: Validation practices, types of quantitation, standard plots for quantitation, strategies and validation parameters, potency method revalidation, common problems and solutions.

6. Validation of chromatographic methods: Overview of methods validation, components of methods validation, method evaluation and further development, final method development and trial methods validation, formal methods validation and report

generation, formal data review and report issuance.

a) Method validation for HPLC analysis

b) Performance verification of HPLC

c) LC-MS instrument calibration

7. Performance verification of UV-Visible spectrophotometers: Introduction, performance

attributes: wavelength accuracy, stray light, resolution, noise, baseline flatness, photometric

accuracy and linearity. Practical tips in UV-Vis performance verification

8. Bioanalytical method validation: Definition of bioanalytical method validation, regulatory guidance on bioanalytical **method** validation, current validation practice, selectivity, reference standard, standard curve, dilutions, recovery, stability, documentation,

common problems and solutions.

9. Quality control of herbal drugs: Introduction, adulteration and deterioration, quality

assurance of herbal drugs, determination of foreign matter, development of standardization

parameters, phytoconstituents and their analysis, analytical procedures for some bioactive

materials, antimicrobial and parasitocidal screening of herbal drugs tests for active pharmaceutical raw materials in herbal drugs.

Course Profile:**Course Title:** Pharmaceutical quality control and analytical method validation -Lab**Course No:** PHARM-416 **Credit Hour:** 1 **Contact Hours:** 1 **Total Marks:****Rationale:**

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	1. Calibration of UV spectrophotometer through absorbance and scanning speed on the UV absorption spectrum of a given drug.		
	2. Determination of the effects of slit width and scanning speed on the UV absorption spectrum of a given drug.		
	3. Determination of the E-Z isomer ration in clomiphene citrate mixture.		
	4. Assessment of the precision of quantitative measurements using HPLC.		

	5. Separation and identification of the xanthene derivatives in tea or coffee by HPLC.		
	6. Gas chromatographic determination of the composition of fatty acids in fixed oils.		
	7. Testing of containers closures, liners, glasses and plasties used for pacing pharmaceutical products.		
	8. Test of packaging materials, cartons, aluminum foils, films used for blister packing, ampoules, vials, etc.		

1. Calibration of UV spectrophotometer through absorbance and scanning speed on the UV absorption spectrum of a given drug.
2. Determination of the effects of slit width and scanning speed on the UV absorption spectrum of a given drug.
3. Determination of the E-Z isomer ration in clomiphene citrate mixture.
4. Assessment of the precision of quantitative measurements using HPLC.
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6. Gas chromatographic determination of the composition of fatty acids in fixed oils.
7. Testing of containers closures, liners, glasses and plasties used for pacing pharmaceutical products.
8. Test of packaging materials, cartons, aluminum foils, films used for blister packing, ampoules, vials, etc.

Book Recommended

1. Pharmaceutical process validation- Ira. R. Berry, Robert. A. Nash.

2. Principles of Instrumental Analysis-Skoog & Leary.
3. Instrumental methods in Analytical chemistry- Dongrow.
4. Good Manufacturing Practice for pharmaceuticals, A Plan for Total Quality Control-Sydney H. Willit, James. R. Stoker.
5. Quality Assurance of pharmaceuticals- World Health Organization.
6. The quantitative analysis of drug- P. C. Garratt.
7. Pharmaceutical analysis- Higuchi, Broclmiann, Hanssen.

Course Profile:

Course Title: Pharmaceutical Marketing & Management

Course No: PHARM-417

Credit Hour: 3 **Contact Hours:** 3

Total Marks:

Rationale:

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Objectives:

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Learning Outcomes	Course Content	Teaching Strategy/ Learning experience	Assessment Strategy
	Part A: Pharmaceutical Marketing		
	1. Principles of marketing		
	2. Strategic marketing planning		
	3. Consumer markets and buying behavior		
	4. Market segmentation and target market strategies		
	5. Product promotion		
	6. Advertisement		
	7. Products: planning and development		
	8. Positioning and product life cycle		
	9. Branding		
	10.Pricing		

	Part B: Pharmaceutical Management 1. Nature and principles of management.		
	2. Organization structures.		
	3. Personal management.		
	4. Product management & inventory control.		
	5. Purchasing.		
	6. Production management.		

Part A: Pharmaceutical Marketing

1. Principles of marketing
2. Strategic marketing planning
3. Consumer markets and buying behavior
4. Market segmentation and target market strategies
5. Product promotion
6. Advertisement
7. Products: planning and development
8. Positioning and product life cycle
9. Branding
10. Pricing

Part B: Pharmaceutical Management

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. Personal management: Importance, principles, methods, motivation, staff requirements theory.

4. Product management & inventory control: Product management, positioning of product, inventory management, ABC concept, inventory reporting and analysis, economic order quantity (EOQ), inventory management system and cost control.

5. Purchasing: Formulating effective buying policies, needs and desires, selecting the sources of supply, determining terms of purchase, receiving, marking and stocking of goods.

6. Production management: GMP & its application, lighting and conditioning specification, dust collection and cross-contamination, weighing area, tablet granulating area, tablet compression area, coating area, area for manufacturing liquids, packaging area, ware housing, shipping and receiving materials, cost control in manufacturing.

Books Recommended:

1. Quantitative Techniques for Managerial Decision Making, by U.K. Srivastava and S. C. Sharma. —
2. Pharmaceutical Marketing by Smith.
3. Principles of Management by Davis. —
4. Principles and Methods of Pharmacy Management by H. A. Smith.
5. Management, A global Perspective by Weirich, Heinz & Kooniz. Personnel management and Industrial Relations, by R. S. Davar.
6. Personnel Management, by Mamoria.
7. Purchasing and Store Keeping, by D. R. Gupta, R. K. Rajput.
8. Managing Drug Supply, management sciences for health.
9. Marketing, Management by Philips Kottler, Printice Hall of India Pvt, Ltd.
10. Marketing Strategy: A Global Perspective by Vernon R. Stauble, The Dryden Press.

Course Profile:**Course Title: Pharmaceutical Regulatory Affairs****Course No: PHARM-418****Credit Hour: 3 Contact Hours: 3****Total Marks:****Rationale:**
.....**Objectives:**
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1. Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976), The Pharmacy Council of Bangladesh-its functions and scopes.
2. Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons: The Drug Act 1940, The Drug Ordinance 1982, The Drug Policy 1982. The Narcotics (control) Act 1990. The Drug Policy 2005, The Poisons Act 1919 and subsequent amendments of these policies acts and ordinances.
3. Approval process, format of registration of pharmaceuticals in Bangladesh.
4. Rules and regulations for controlling poisons and narcotic materials in-Bangladesh.
5. Control of drug advertisements and prices, patented and trade marked medicine. proprietary medicine, regulation of cosmetics and poison control.
6. Schedules of drugs and poisons.
7. The Pharmacist's code of ethics.

Books Recommended:

1. Pharmacy Ordinance, 1976. Ministry of Law and Parliamentary Affairs, Government of peoples republic of Bangladesh.
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, Government of Bangladesh.
4. A Textbook of Forensic Pharmacy by B.M Mithal.
5. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh.
6. Remington: The Science & Practice of Pharmacy - Alfonso R. Gennaro

Course Profile:

Course Title: Project

Course No: PHARM-419

Credit Hour: 3

Contact Hours: 3

Total Marks:

Rationale:

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Objectives:

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Course Profile:

Course Title: In-Plant Training

Course No: PHARM-420

Credit Hour: 1.5

Contact Hours: 1.5

Total Marks:

Rationale:

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Objectives:

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Course Profile:

Course Title: Viva-Voce

Course No: VV-411 **Credit Hour:** 1 **Contact Hours:** 1 **Total Marks:**

Rationale:

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Objectives:

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