

# DEPARTMENT OF PHARMACY

Faculty of Science

## COMILLA UNIVERSITY

Kotbari, Comilla-3506, Bangladesh



## SYLLABUS

of

### Bachelor of Pharmacy (B. Pharm)

Sessions: 2019-2020, 2020-2021, 2021-2022

#### **Preface:**

Comilla University introduces a five (05) year Bachelor of Pharmacy (B. Pharm) degree program under the Faculty of Science, Department of Pharmacy to produce competent pharmacists. Pharmacy is practiced in a wide range of settings including the pharmaceutical industry, drug research and development, pharmaceutical regulations, community pharmacies, hospitals and many other health sectors.

#### **Qualification for Admission:**

Student passing the Higher Secondary Certificate (H.S.C) examination in science from an education board of Bangladesh or a recognized equivalent examination from home and abroad may be admitted to the program of Bachelor of Pharmacy in this university on such terms and conditions as may be determined by the university from time to time.

### Course Curriculum:

The courses of study for the degree of Bachelor of Pharmacy under the Department of Pharmacy will extend over five academic years. Each academic session of the program will be held in two (02) six monthly semesters. Examination will be held at the end of each semester under the following heads:

#### Syllabus Structure

Examination	Semester	Credits	Total Credits
B. Pharm. 1 <sup>st</sup> Year	First	15	31
	Second	16	
B. Pharm. 2 <sup>nd</sup> Year	First	17	34
	Second	17	
B. Pharm. 3 <sup>rd</sup> Year	First	23	46
	Second	23	
B. Pharm. 4 <sup>th</sup> Year	First	22	45
	Second	23	
B. Pharm. 5 <sup>th</sup> Year	First	22	44
	Second	22	
<b>Grand Total of Credits</b>			<b>200</b>

### Duration of Theory Examination

For 3 credit courses - 3 hours

For 2 credit courses - 2 hours

**Hospital Pharmacy Training:** All students will be required to complete 600 hours on hospitals pharmacy practices during B. Pharm Year V: Semester-10 (4<sup>th</sup> year 2<sup>nd</sup> semester). Marks distribution will be as follows:

- i) Report examination= 80%
- ii) Oral assessment = 20%

**Industrial Pharmacy Training:** All students will be required to complete training in pharmaceutical company during B. Pharm Year IV: Semester- 8 (5<sup>th</sup> year 2<sup>nd</sup> semester). Marks distribution will be as follows:

- i) Report examination= 80%
- ii) Oral assessment = 20%

**Research Project:** All students will be required to accomplish a research project during B. Pharm Year V: Semester-10 (5<sup>th</sup> year 2<sup>nd</sup> semester). Marks distribution will be as follows:

- i) Report examination= 80%
- ii) Oral assessment = 20%

### **Total Credit Hours Requirement and Duration of the Program:**

To obtain Bachelor of Pharmacy (B. Pharm.) degree, students will have to complete 200 credit hours with a minimum CGPA of 2.25. The program having 10 semesters normally extends over a period of **5 (five)** academic years and shall be completed by a student in not more than **7 (seven)** academic years.

### **Duration of the Academic Program:**

The duration of the program shall be 5 (five academic years divided into 10 (ten) semesters. Each academic year is divided into two semesters to be called as 1<sup>st</sup> semester and 2<sup>nd</sup> semester.

An academic semester comprised of six months is distributed as follows:

i.	Class Teaching (actual class)	= 13 weeks
ii.	Preparation time for semester final examination	= 2 weeks
iii.	Semester final examination	= 3 weeks
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<b>Total</b>		<b>= 18 weeks</b>

Final examination may be scheduled during holidays. Within one week after the semester final examination classes of the next semester will resume.

#### a) Definition of credit hour:

- One credit hour refers to one lecture hour per-week for thirteen weeks.

#### b) Gap between examinations of two courses

- Full unit (3 credits) - not more than 3 days' gap between two courses. (if weekly or national holidays do not make it longer)
- Half unit (2 credits) - not more than 2 days' gap between two courses. (if weekly or national holidays do not make it longer)

### **Medium of Instruction:**

The medium of instruction of 5-years Bachelor of Pharmacy (B. Pharm.) program shall be English.

### **Class Hours (50 minutes each)**

Theoretical and Practical courses shall be so designed as to be completed of the following class hours:

- Theoretical courses of 2 credits in 26 class hours and 3 credits in 39 class hours
- Practical courses of 1 credits in 13×2 class hours and 2 credits in 13×4 class hours

### **Degree Requirements:**

#### **1. For a student requires to:**

- Earn required number of total credit points successfully;
- Earn a minimum CGPA of 2.25; and
- Complete the program within seven academic years from her/his 1<sup>st</sup> admission to the program.

#### **b. Award of (Pass) Degree:**

- A student who fails to secure a minimum CGPA of 2.25 after completing ten semester final examination but succeeds in securing a CGPA between 2.00 and 2.25 will be eligible for a Pass Degree.

### **Examination Entry Requirements:**

A student will be allowed to take part in semester final examination if s/he fulfills the following conditions:

- If the student has registered for the concerned semester in due time.
- If s/he has the required percentage of attendance in each course lecture.

- c. If the student has paid all dues (registration fees/tuition fees/other charges) applicable to university administration/residential hall administration etc.)
- d. If the student has not been instructed by the Disciplinary Board/Examination Disciplinary Committee to refrain from taking part in the examination.

**Improvement of Grade:**

Only the removal of 'F' (Fail) in any course shall be allowed. Removal of 'F' in any course is permitted sitting in the final examination only for two (2) times in subsequent two semesters excluding the regular examination.

**Drop Out:**

- a. If a student re-admitted twice in any semester fails to earn minimum required credits for promotion shall be dropped out from the programme.
- b. If a student fails to earn required total credit points within seven academic years since admissions, s/he will be dropped-out from the programme and will no more be allowed to continue his/her studentship with other programmes.

**Re-admission:**

- a. A student failing to earn the requisite credit points for promotion from one semester to the next may seek re-admission with the following batch.
- b. For re-admission a student shall have to apply within one month after the announcement of the result of the concerned semester.

**Credit Transfer:**

No Credit transfer from any other programmes /University /Institutions to the Comilla University is allowed.

**Evaluation System:**

**A. Theoretical courses**

Each theoretical course offered should be composed of either 50 (each 50 marks course consisting of 2 credit point) or 100 marks (each 100 marks course consisting of 3 credit point). The proportion of the total marks of a particular course shall be distributed as follows:

Continuous Assessment /Before-Final Assessment	40%
Semester-Final Examination	60%
<b>Total = 100%</b>	

**Continuous Assessment:** Marks allocated for before-final assessment shall be distributed as follows:

i. **Internal Evolution:**

a) Mid-Semester examination (at least two mid-semester exams.)	20%
b) Class test and/or quiz and/or in-course and/or sudden test and/or tutorial and/or assignment and/or term paper preparation & presentation/ case study and/or practical and/or field work*	15%
Class Attendance	5%
<b>Total = 40%</b>	

ii **Class Attendance:** The marks allocated for class attendance shall be given as following proportions:

<b>Attendance</b>	<b>Marks</b>
90% and above	100%
85% to less than 90%	90%
80% to less than 85%	80%
75% to less than 80%	70%
70% to less than 75%	60%
65% to less than 70%	50%
60% to less than 65%	40%
Less than 60%	0%

\*Concerned department and/or course teacher will decide the allocation of this mark in different activities.

**Class-Attendance Requirements to Appear in the Semester Final Examination:**

- i. If class attendance of any student at any course is below 60%, but in the range of 40% to 59%, s/he will be allowed to attend the examination only with the recommendation of the course teacher and approval of the chairman of the department. In such cases the student will have to pay a fine as fixed by the authority/department.
- ii. A student with class attendance of less than 40% in any course will be debarred from appearing in the Final Examination.

**Letter Grade and Grade point:** Total marks obtained in each course, oral (viva-voce) examination and practical courses shall be converted into LG (Letter Grade) and GP (Grade point) as follows:

<b>Numerical Grade</b>	<b>Letter Grade</b>	<b>Grade point</b>	<b>Interpretation</b>
80% and above	A+ (A Plus)	4.00	Outstanding
75% to less than 80%	A (A regular)	3.75	Excellent
70% to less than 75%	A- (A minus)	3.50	Very Good
65% to less than 70%	B+ (B Plus)	3.25	Good
60% to less than 65%	B (B regular)	3.00	Satisfactory
55% to less than 60%	B- (B minus)	2.75	Below Satisfactory
50% to less than 55%	C+ (C Plus)	2.50	Average
45% to less than 50%	C (C regular)	2.25	Pass
40% to less than 45%	D .....	2.00	Poor
Less than 40%	F .....	0.00	Fail

\* In the Transcript/Grade sheet, only the Letter Grade and the Corresponding Grade points, and final CGPA (in the 10<sup>th</sup> Semester), not the numerical marks, will be shown.

## B. Practical Courses

### *Credit specification:*

Different credits will be assigned to laboratory courses as mentioned in the syllabus of the department on the basis of importance. Two laboratory hours per week for the duration of 13 weeks will be considered as one (1) credit and four laboratory hours per week for the duration of 13 weeks will be considered as two (2) credits.

### *Laboratory Examination:*

For lab courses students will be evaluated in two phases. The marks distribution will be as follows:

#### **Continuous Assessment: 40%**

Lab Attendance:	10%
Lab Performance:	20%
Lab Report Writing:	10%

#### **Final Assessment: 60%**

Evaluation on Experiments:	50%
Viva-voce:	10%

Detail distribution of marks for the evaluation on experiment will be decided by the examination committee and the course teachers.

## Courses and Credits

<b>B. Pharm 1<sup>st</sup> Year: 1<sup>st</sup> Semester</b>		
<b>Course Code</b>	<b>Course Title</b>	<b>Credit/s</b>
PHARM 1101	Introduction to Pharmacy	2
PHARM 1102	Pharmacognosy and Phytochemistry-I	3
PHARM 1103	Pharmaceutical Inorganic Chemistry-I	3
PHARM 1104	Pharmaceutical Organic Chemistry-I	3
PHARM 1105	Computer Applications in Pharmacy	2
PHARM 1106	Basic Mathematics	2
<b>Total Credits</b>		<b>15</b>
<b>B. Pharm 1<sup>st</sup> Year: 2<sup>nd</sup> Semester</b>		
PHARM 1201	Pharmaceutical Microbiology and Immunology	3
PHARM 1202	Pharmacognosy and Phytochemistry-II	3
PHARM 1203	Physiology and Anatomy-I	3
PHARM 1204	Pharmaceutical Engineering	3
PHARM 1205	Pharmaceutical Microbiology and Immunology-Lab	1
PHARM 1206	Pharmacognosy and Phytochemistry-Lab	2
PHARM 1207	Viva voce	1
<b>Total Credits</b>		<b>16</b>

<b>B. Pharm 2<sup>nd</sup> Year: 1<sup>st</sup> Semester</b>		
PHARM 2101	Pharmaceutics-I	3
PHARM 2102	Pharmaceutical Inorganic Chemistry-II	3
PHARM 2103	Pharmaceutical Organic Chemistry-II	3
PHARM 2104	Physical Pharmacy-I	3
PHARM 2105	Pharmaceutics-I-Lab	1
PHARM 2106	Pharmaceutical Inorganic Chemistry-Lab	2
PHARM 2107	Pharmaceutical Organic Chemistry-Lab	2
<b>Total Credits</b>		<b>17</b>
<b>B. Pharm 2<sup>nd</sup> Year: 2<sup>nd</sup> Semester</b>		
PHARM 2201	Biochemistry and Molecular Biology	3
PHARM 2202	Physiology and anatomy-II	3
PHARM 2203	Physical Pharmacy-II	3
PHARM 2204	Applied Microbiology	2
PHARM 2205	Biochemistry and Molecular Biology-Lab	1
PHARM 2206	Physiology and Anatomy-Lab	2
PHARM 2207	Physical Pharmacy-Lab	2
PHARM 2208	Viva voce	1
<b>Total Credits</b>		<b>17</b>
<b>B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester</b>		
PHARM 3101	Pharmaceutical Analysis-I	3
PHARM 3102	Medicinal Chemistry-I	3
PHARM 3103	Biopharmaceutics-I	3
PHARM 3104	Pharmacology-I	3
PHARM 3105	Pharmaceutical Biotechnology	3
PHARM 3106	Pharmaceutical Law and Ethics	3
PHARM 3107	Pharmaceutical Analysis-I-Lab	2
PHARM 3108	Medicinal Chemistry-I-Lab	2
PHARM 3109	Pharmacology-I-Lab	1
<b>Total Credits</b>		<b>23</b>

<b>B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester</b>		
PHARM 3201	Pharmaceutics-II	3
PHARM 3202	Pharmacology-II	3
PHARM 3203	Biopharmaceutics -II	3
PHARM 3204	Clinical Pathology	3
PHARM 3205	Pharmaceutical Marketing and Management	3
PHARM 3206	Pharmaceutical Regulatory Affairs	3
PHARM 3207	Pharmaceutics -II-Lab	1
PHARM3208	Pharmacology-II-Lab	1
PHARM 3209	Biopharmaceutics-Lab	2
PHARM 3210	Viva voce	1
<b>Total Credits</b>		<b>23</b>

<b>B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester</b>		
PHARM 4101	Pharmaceutical Analysis-II	3
PHARM 4102	Medicinal Chemistry-II	3
PHARM 4103	Drug and Disease Management-I	3
PHARM 4104	Clinical Pharmacy	3
PHARM 4105	Biopharmaceutics-III	3
PHARM 4106	Hospital and Community Pharmacy	3
PHARM 4107	Pharmaceutical Analysis-II-Lab	2
PHARM 4108	Medicinal Chemistry-II-Lab	2
<b>Total Credits</b>		<b>22</b>
<b>B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester</b>		
PHARM 4201	Pharmaceutics-III	3
PHARM 4202	Pharmacology-III	3
PHARM 4203	Cosmetology	3
PHARM 4204	Pharmaceutical Analysis-III	3
PHARM 4205	Medicinal Chemistry-III	3
PHARM 4206	Pharmaceutics-III-Lab	1
PHARM 4207	Pharmacology-III-Lab	1
PHARM 4208	Cosmetology-Lab	2
PHARM 4209	Hospital Pharmacy Training	3
PHARM 4210	Viva voce	1
<b>Total Credits</b>		<b>23</b>
<b>B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester</b>		
PHARM 5101	Quality Control and Analytical Method Validation	3
PHARM 5102	Food, Nutraceuticals and Agrovet	3
PHARM 5103	Drug and Disease Management-II	3
PHARM 5104	Clinical Research Methodology and Clinical Pharmacokinetics	3
PHARM 5105	Biostatistics& Bioinformatics	3
PHARM 5106	Pharmaceutics-IV	3
PHARM 5108	Quality Control and Analytical Method Validation-Lab	2
PHARM 5109	Clinical Pharmacy and Pharmacokinetics-Lab	2
<b>Total Credits</b>		<b>22</b>
<b>B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester</b>		
PHARM 5201	Toxicology and Drug Interactions	3
PHARM 5202	Pharmacy Practice	3
PHARM 5203	Drug and Disease Management-III	3
PHARM 5204	Pharmacology-IV	3
PHARM 5205	Pharmaceutical Industry Training	4
PHARM 5206	Research Project	4
PHARM 5207	Viva voce	2
<b>Total Credits</b>		<b>22</b>

**B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup>Semester**  
**Course Title: Introduction to Pharmacy**  
**Course Code: PHARM 1101**  
**Credits: 2**

- 1. History and Evaluation of Pharmacy:** Ancient ages, middle ages, modern ages, development of pharmacy in International and Bangladesh, important pharmacy dates.
- 2. Pharmacy Education:** Definition of pharmacy, specialty of pharmacy education, brief introduction of the courses taught in a pharmacy program, pharmacy education in Bangladesh and other countries.
- 3. Pharmacy Occupation and Profession:** Difference between occupation and profession, pharmacy as a profession, definition and characteristics of pharmacy profession, social recognition and status of pharmacy profession, scopes and opportunities for pharmacists, career development in pharmacy – International and Bangladesh perspective, concept of model pharmacy in Bangladesh.
- 4. Pharmacists' Code of Ethics:** Oath of a pharmacist, professional pharmacy organizations in Bangladesh and abroad, local and foreign drug regulatory bodies.
- 5. Drugs and Medicines:** Definition and difference between drug and medicine, sources of drugs, classification of drugs on the basis of actions, target organs, chemical, generic and brand names, different types of dosage forms, Different system of medicine, Who and essential drug concept.
- 6. Drug Standards:** Different pharmacopoeias and formularies (USP, BP, NF, BNF, BDNF etc.), pharmaceutical codex, index official, non-official, unofficial and INN drugs (new drugs), monographs of drugs, drug regulation and control.
- 7. Pharmacy Information Resources:** Books, reference and test books, journals, software etc, pharmacy information in the internet, pharmacy journals – home and abroad, study of scientific papers.

**Recommended Books:**

1. R. Hendrickson et. Al.(ed) Remington : The Science and Practice of Pharmacy
2. L. Shargel and Larry N.Swanson : Comprehensive Pharmacy Review
3. A I Wertheimer and M C Smith : Pharmacy practice: Social and behavioral aspects
4. Dr. Md. Shah Amran : Introduction to Pharmacy
5. Dr. Md. Shah Amran : Pharmacy, Pharmaceutical sector and Healthcare

\* Other Books will be indicated by respective teachers

**B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmacognosy and Phytochemistry-I**  
**Course Code: PHARM 1102**  
**Credits: 3**

- 1. Introduction to Pharmacognosy:** Definition, scope and historical development of Pharmacognosy. Plant cell: Its structure, function and form, introduction to the general structure of the morphological parts of the plants.
- 2. 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, drug adulteration, evaluation of crude drugs.
- 3. Plant Analysis:** Extraction, separation, chromatography; types of plant constituents, comparative phytochemistry and chemotaxonomy.
- 4. Lipids:** Definition, classification, properties and extraction of the following-
  - a) Plant origin: castor oil, coconut oil, linseed oil, olive oil, peanut oil and chaulmoogra oil.
  - b) Animal origin: cod liver oil, shark liver oil, hilsha fish/liver oil etc.
  - c) Waxes
- 5. Carbohydrate and Related Compounds:** Definition, classification, properties and biosynthesis.
  - a) Monosaccharides and oligosaccharides: Sucrose, dextrose, glucose, fructose etc.
  - b) Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose, etc.
- 6. Contribution of Traditional Drugs to Modern Medicines:** Details of some common indigenous traditional drugs: punarnava, vashaka, anantamul, arjuna, chirata, picrorhiga, kalomegh, amla, asoka, bahera, haritaki, tulsi, neem, betel nut, joan, karela, shajna, carrot, bael, garlic, black cumin, jam and madar.
- 7. Surgical Dressings and Fibres:** Classification, importance and brief study of different types of surgical dressings and fibres.

#### Recommended Books:

- |                                  |   |
|----------------------------------|---|
| 1. E. P. Claus and V.E. Tyler    | : Pharmacognosy                                 |
| 2. W.C. Evans                    | : Trease and Evan's Pharmacognosy               |
| 3. C K Kokate, A P Purohit       | : A text book of Pharmacognosy                  |
| 4. Mohammed Ali                  | : Textbook of Pharmacognosy                     |
| 5. K. Raghunathan and Roma Mitra | : Pharmacognosy of Indigenous Drugs Vol. I & II |
| 6. R. N. Chopra, S. L. Nayer     | : Glossary of Indian Medicinal Plants           |
| 7. M. A. Ghani                   | : Text book of Pharmacognosy                    |

\* Other necessary books will be referred by the respective course teachers.

**B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Inorganic Chemistry-I**  
**Course Code: PHARM 1103**  
**Credits: 3**

- 1. Atomic Structure:** Subatomic particles; Cathode rays, positive rays,  $\alpha\beta$  and  $\gamma$ -rays, Isotope, Isotone, Isobar, determination of atomic number, Rutherford's atomic model, electromagnetic spectrum, quantum numbers, Bohr atomic model, electron cloud and orbital, electronic configuration of atoms; Pauli's exclusion principle, Hund's rule, Aufbau principle, shapes of s, p, d, f orbitals.
- 2. Chemical Bonding:** Bonding and non-bonding electrons, electronic theory of valency, ionic bond, covalent bond, coordinate covalent bond, octet rules, characteristics of ionic, covalent and coordinate covalent compounds, Van der Waals force, polar covalent bonds – hydrogen bond, metallic bond, theories of covalent bonding and hybridization.

**3. Periodic Table:** Mendeleev's Periodic law, Modern periodic table and periodicity of elements, variation of periodic properties within periods and groups, ionization potential, electron affinity, electronegativity, importance and limitation of periodic table.

**4. Coordination Compounds and Complexation:** 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, valence bond theory, application of complexes in pharmacy.

**5. Oxidation Reduction Reactions:** Definition, oxidation number, equivalent weight of oxidant and reductant, decomposition of drugs by redox reaction, ion electron method of balancing equation, importance and determination of redox potential.

**6. Gases of Pharmaceutical Applications:** Medicinal gases (oxygen, nitrogen, carbon dioxide, helium, nitrous oxide, mixtures), Inert gases and their sources, electronic configuration and inertness, isolation of inert gases from dry air (chemical method) and liquid air (physical method), physical & chemical properties and uses of noble gases, conditions and types of compounds formed by inert gases.

**7. Basic Concept on Acids, Bases, Salts and pH:** Definitions, various theories of acids & bases, classification of acids, bases & salts, Strength of acids & bases, determination of strength gradient of acids & bases.

**8. Electrolytes and Essential Trace Elements:** (i) Electrolytes: Intra and extra cellular electrolytes (Na, K, Ca and Cl ions), electrolytes used in replacement therapy, acid – base balance therapy, and combination therapy of electrolytes. (ii) Trace Elements: Essential trace elements (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), values of copper, zinc, manganese in biological conditions and their official products.

#### **Recommended Books:**

1. S. Z. Haider : Introduction to Modern Inorganic Chemistry
2. Satya Prakash, Tuli, Basu and Madan : Advanced Inorganic Chemistry
3. R.D. Madan : Modern Inorganic Chemistry
4. B.R. Puri and L.R. Sharma : Principles of Inorganic Chemistry

\* Other Books will be indicated by respective teachers.

### **B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup> Semester**

#### **Course Title: Pharmaceutical Organic Chemistry-I**

**Course Code: PHARM 1104**

**Credits: 3**

**1. Introduction to Organic Chemistry:** History of organic chemistry, classification of organic compounds, systematic naming of organic compounds, electronegativity, polarity of molecules, structure and physical properties, intermolecular forces, inductive effects, bond length, bond angles and bond strength, carbonium ions, carbanions, electrophiles, nucleophiles, free radicals, hydrogen bonding, m.p., b.p., solubility of organic compounds etc. Aromaticity, benzene and substituted benzenes, electrophilic aromatic substitution 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) Aldehydes and Ketones:** Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

c) **Alcohols, Ethers and Epoxides:** 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. Chemistry of Aromatic Compounds:** Aromaticity, mechanism of orientation and substitution and resonance preparations, reactions and pharmaceutical importance of simple aromatic compounds, aromatic halogen compounds, aromatic nitro compounds, aromatic amino compounds, diazonium salts and related compounds, sulphonic acids, phenols, alcohols, aldehydes, ketones and aromatic acids.

**4. Carbohydrates:**

a) **Monosaccharides and Disaccharides:** Nomenclature, classifications, general reactions, configurations and pharmaceutical importance of monosaccharides and disaccharides.

b) **Polysaccharides:** Composition, structure, properties and pharmaceutical importance of starch and cellulose.

**Recommended Books:**

1. B.S. Bahl and Arun Bahl : Advanced Organic Chemistry
2. R.T. Morrison and R.N. Boyd : Organic Chemistry
3. I.L. Finar : Organic Chemistry Vol. I & II
4. Ashutosh Kar : Medicinal Chemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup> Semester**

**Course Title: Computer Applications in Pharmacy**

**Course Code: PHARM1105**

**Credits: 2**

**1. Introduction to Computers:** History of development of computer, application and scope of computer in pharmacy- drug discovery and development, formulation and dosage form research and development, hospital management, prescription and patient management, preclinical and clinical trials, biopharmaceutical data analysis, industry management, quality control and analysis, chemo-informatics and bioinformatics, drug information system etc.

**2. Classification of Computer:** Mainframe, mini and micro computer, computer architecture- a general review of INPUT/OUTPUT media and devices, functional part and organization of central processing unit, memory and memory storage devices, micro processors, number systems- binary, hexadecimal etc., hardware, software, batch processing, RAM, ROM etc.

**3. Operating Systems:** Introduction to different types of operating system-Unix, MS-DOS, WINDOWS, OS 2 WARP etc, introduction to word processing software (MS Word, WordPerfect etc), introduction to analytical software (SPSS).

**4. Programming Languages:** Introduction to machine language, interpreter, compiler, assembler language; High level language- basic, C++, PASCAL, FORTRAN etc, algorithm, flowchart, decision table, basic idea of programming, data file and data base.

**5. Introduction to Computer Network:** Internet and netsurfing using Netscape- basic principles, gateway and bridge, Internet Protocol (IP), protocol translation, information retrieval.

**Recommended Books:**

1. Fassett : Computer Applications in Pharmacy.
2. R. White : How computers work.
3. Ron Mansfield : Working in Microsoft Office.
4. V. K. Jain. : Basic Programming.

\* Other necessary books will be referred by the respective course teacher.

**B. Pharm 1<sup>st</sup>Year: 1<sup>st</sup> Semester**  
**Course Title: Basic Mathematics**  
**Course Code: PHARM 1106**  
**Credits: 2**

- 1. Introduction to Mathematics:** Variables, constant and parameter, co-ordination system with graph.
- 2. Functions:** Odd function, Even function, one-one function, onto function, variable substitution in function, composition of functions.
- 3. Limit of Function:** Limit, graphical representation of limit, Evaluation of different types of limit.
- 4. Graphs and Gradients:** (a) Rectangular co-ordinates, curve fitting gusing 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.
- 5. 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.
- 6. Matrices:** Addition, subtraction and multiplication of matrices, unit matrix, row transformation, determinants, inverse of a matrix, solution of equation by matrix.

**Recommended Books:**

1. Das and Mukherjee : Integral Calculus
2. Md. Iman Ali : Matrices
3. Khosh Muhammad and Bhattacharjee : Differential Calculus
4. Md. Yusuf : Differential Calculus

\* Other necessary books will be referred by the respective course teacher.

**B. Pharm 1<sup>st</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutical Microbiology and Immunology**  
**Course Code: PHARM 1201**  
**Credits: 3**

**1. Introduction to Microbiology:** Definition, microbiology as a field of biology, place of microbiology in the living field, prokaryotic and eucaryotic protists, group of microorganisms– nomenclature, type and nature,, areas of microbiology, scope of microbiology with special reference to pharmaceutical sciences.

**2. Bacteria:**

- a) Nomenclature of bacteria, general characteristics of bacteria.
- b) General and cellular morphology - size, shape, fine structures and movement.
- c) Cultivation of bacteria: nutritional requirements, factors affecting growth, bacteriological media.
- d) Reproduction and growth: Modes of cell division, normal growth cycle, growth curve, synchronous growth and quantitative measurement of growth.
- e) Pure culture and cultural characteristics: Methods of isolation, maintenance and preservation of pure cultures, colony characteristics and characteristics of broth culture, maintenance and preservation of pure culture of bacteria.
- f) Microbial metabolisms: Introduction, biogenesis, anabolism, catabolism, metabolic versatility of organisms, enzymes, energy production by aerobic & anaerobic processes, fermentation processes.

**3. Virus:**

- a) History of viruses, general properties of viruses, classification of viruses, characteristics of viruses, reproduction and cultivation of viruses, virus inhibition, control of viral infections.
- b) Bacterial virus or bacteriophages: Morphology, composition and life cycle, cultivation of bacterial viruses, virus & diseases, applications in life sciences.

**4. Other Microorganisms (brief study):**

- a) **Fungi**- pharmaceutical importance, characteristics, morphology, reproduction (sexual & asexual), cultivation, classification of fungi, some fungi of special interest (Penicillium, Candida, Aspergillus, Rhizopus), diseases caused by fungi.
- b) **Rickettsiae** – Introduction, characteristics of rickettsiae, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases.

Brief study of actinomycetes

**5. Basic Concepts of Immunology:** Introduction, types of immune systems, non specific and specific components of the immune system, immune regulation and diversity, types of immunity, Infections, pathogenicity and virulence immunity, hypersensitivity, Inflammation, autoimmunity, cancer immunotherapy, immunodiagnosics and immunological products (vaccines, toxoids, sera).

**Recommended Books:**

- 1. M.J. Pelczar, E.C.G. Chan and N.R. Kreig : Microbiology
- 2. Tortora, Funke : Microbiology Introduction
- 3. Stainer, Ingraham, Wheelis and Painter : General Microbiology
- 4. R. Ananthanarayan and C. K. J. Paniker : Textbook of Microbiology
- 5. M. R. Choudhury : Modern Medical Microbiology
- 6. Ivan Roitt, J. Brostoff and David Male : Immunology
- 7. Abul K. Abbas, A.H. Lichtman and J.S. Pober : Cellular and Molecular Immunology
- 8. W.H. Elliott and D.C. Elliott : Biochemistry and Molecular Biology
- 9. S. J. Carter : Cooper and Gunn’s Tutorial Pharmacy
- 10. Samuel Cate Prescott, Cecil Gordon Dunn : Prescott and Dunn’s Industrial Microbiology
- 11. Salle : Fundamental Principles of Bacteriology

\* Other Books will be indicated by respective teachers.

**B. Pharm 1<sup>st</sup>Year: 2<sup>nd</sup>Semester**  
**Course Title: Pharmacognosy and Phytochemistry-II**  
**Course Code: PHARM 1202**  
**Credits: 3**

**1. Phytochemistry and Pharmaceutical Uses of the Following Plant Constituents:**

**A. Glycosides and Glycoside-containing Drugs:** Classification and biosynthesis of glycosides. The details of the following:

a) Phenols and phenolic glycosides.

- i) Simple phenols: Vanilla and vanillin, capsicum
- ii) Tannins: Galls or nutgall, hamamelis.
- iii) Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb.

b) Saponins, cardioactive drugs and other steroids.

- i) Steroidal saponin: Sarsaparilla root, ginseng, glycyrrhiza.
- ii) Pentacyclic triterpenoid saponin.
- iii) Cardioactive glycosides: Digitalis, strophanthus, squill.
- iv) Cyanogenic glycoside: Wild cherry, mustard.
- v) Miscellaneous isoterpenoids: Gentain, valerian root, quassia, fish berries, santonica flower, saffron.

c) Other glycosides(alcohol, aldehyde, lactone, phenol, flavonoid) and neutral principles: Willow bark, Vanilla, Cantharide, Uva ursi, Gentian, Quassia, Saffron etc.

**B. Alkaloids:** Classification and biosynthesis of tropane, quinoline, isoquinoline and indole alkaloids. The details of the following:

- i) Tropane: Belladonna, stramonium, hyoscyamus and coca leaf.
- ii) Quinoline: Cinchona, cusparia bark.
- iii) Isoquinoline: Ipecac, opium, sanguinaria, curare.
- iv) Indole: Rauwolfia, nux vomica, ergot, catharanthus.
- v) Imidazole: Pilocarpine.
- vi) Steroidal: Veretrum viride, aconite.
- vii) Norlupinane: Lupinus sp.
- viii) Purine base: Coffee, tea and cocoa.

**C. Resin and Resin Combinations** (e.g. resin, oleoresin, oleo gum resin, balsam): Definition, chemistry, uses in pharmacy; brief study of podophyllum, jalap, cannabis, capsicum, ginger, myrrh, tolu balsam, and benzoin:

**D. Volatile Oils and Related Terpenoids:**Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oil. The details of the following:

- i) Terpenes or sesquiterpenes: Turpentine, juniper, cade.
- ii) Alcohol's: Coriander, sandalwood, rose.
- iii) Ester: Peppermint, lavender, rosemary.
- iv) Aldehydes: Cinnamon bark, lemon peel, lemon grass.
- v) Ketones: Spearmint, caraway, dill, camphor.
- vi) Phenols: Clove, thyme, cinnamon leaf, ajowan
- vii) Ethers: Fennel, nutmeg, eucalyptus, anise, cajunut.
- viii) Peroxides: Chenopodium.
- ix) Others: Wintergreen, bitter almond.

**2. Herbs as Health Foods:** Definition, chemistry, uses in pharmacy; brief study of alfa alfa, apricot pits, arnica, garlic, onion, ginseng, ginko biloba, spiriluna, fenugreek, sassafras, honey etc.

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

**Recommended Books:**

- |                                  |   |
|----------------------------------|---|
| 1. E. P. Claus and V.E. Tyler    | : Pharmacognosy                                 |
| 2. W.C. Evans                    | : Trease and Evan's Pharmacognosy               |
| 3. C K Kokate, A P Purohit       | : A text book of Pharmacognosy                  |
| 4. Mohammed Ali                  | : Textbook of Pharmacognosy                     |
| 5. K. Raghunathan and Roma Mitra | : Pharmacognosy of Indigenous Drugs Vol. I & II |
| 6. R. N. Chopra, S. L. Nayer     | : Glossary of Indian Medicinal Plants           |
| 7. M. A. Ghani                   | : Text book of Pharmacognosy                    |

\* Other Books will be indicated by respective teachers.

**B. Pharm 1<sup>st</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Physiology and Anatomy I**  
**Course Code: PHARM1203**  
**Credits: 3**

**1. Introductory Physiology and General Physiology:** Physiology and its scope in pharmacy, RNA, DNA, body fluid compartments and composition of body fluid, transport across cell membrane and membrane potentials, intercellular communication and homeostasis.

**2. Cell and Tissue:** Structure and function, cell inclusions, division of cells; **Tissue:** Definition, classification, structure and function of epithelial tissues, connective tissue, muscular tissue and nervous tissue.

**3. Blood System:**

**a) Plasma:** electrolytes, proteins and other organic constituents;

**b) Blood cells:** Formation and destruction, cell constituents, functions of different blood cells.

**c) Haemoglobin:** Structure and function, haemoglobinopathy, thalassemia; anaemia-causes and classification; blood coagulation and anticoagulation, blood group and transfusion, type of blood vessels and their function.

**d) Lymph:** composition, circulation and function, lymph nodes and lymphatics.

**4. Cardiovascular System:** Heart- structure and blood circulation, cardiac muscles and 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 defaecation; secretion of digestive juices from saliva, stomach, pancreas; functions of digestive juices and their mechanism and regulation of secretions; digestion and absorption of various food stuffs; liver and 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, transport of O<sub>2</sub> and CO<sub>2</sub>, hypoxia and eschemia- causes and classification.

**Recommended Books:**

1. C.C. Chatterjee : Human Physiology Vol. I & II
2. Guyton : A Textbook of Medical Physiology
3. Shahan et al. : Human Physiology
4. W. F. Ganong : Review of Medical Physiology
5. S. Wright : Applied Physiology
6. Selim Reza : The Essentials of Human Physiology
7. Stryer : Biochemistry
8. Lehninger et al. : Principles of Biochemistry
9. A.C. Dev : Fundamental of Biochemistry

\* Other necessary books will be referred by the respective course teacher.

**B. Pharm 1<sup>st</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutical Engineering**  
**Course Code: PHARM 1204**  
**Credits: 3**

- 1. Drying:** Definition, importance of drying, terminology, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content. equilibrium moisture content, classification : direct, indirect, radiation, dielectric, batch and continuous, dryers, types of beds: static, moving, fluidized, pneumatic bed systems, different drying equipments(construction, operation, merits, demerits): tray dryer, through-circulation dryer, pneumatic conveying dryer, different types of dryers.
- 2. Filtration:** Definition, importance of filtration, difference with expression, sedimentation and drying. Classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment :(construction, operation, merits and demerits) the gravity nutsche, delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, Eimco-Burwell plates and frames, Readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney Hunt pressure filter, Moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipment.
- 3. Centrifuges:** General principles, magnitude of centrifugal force, materials of construction, critical speed. sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.
- 4. Mixing:**
  - a) Solid-Solid Mixing:** Importance, fundamentals, batch homogeneity, different types of solids-mixing machines there advantages and disadvantages.
  - b) Paste Mixing:** Definition, importance, simple blending, dispersion operations and general equipment design. Various paste mixers there advantages and disadvantages.
  - c) Liquid Mixing:** Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, others liquid mixers their advantages and disadvantages.
- 5. Milling:** Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process, methods of size reduction by cutter mill, roller mill, hammer mill, ball mill, vibration

mill, edge runner mill, end runner mill, fluid energy mill, hand mill, colloid mill (principle, design, operation and advantages) and selection of a mill.

#### 6. Air Conditioning, Refrigeration & Humidity Control:

- a) **Air conditioning:** Definition, importance, pharmaceutical application, differences between air conditioner & air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air conditioned room, pharmaceuticals needing air conditioning.
- b) **Refrigeration:** Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage.
- c) **Humidity control:** Terminology (psychrometry, absolute humidity, relative humidity, dew point, humid heat, humid volume, wet bulb temperature and adiabatic saturation temperature), relationship between wet bulb and adiabatic saturation temperatures, humidifier, dehumidifier, uses of psychometric charts, measurement of humidity and applications of humidity control.

#### Recommended Books:

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

\* Other Books will be indicated by respective teachers.

### B. Pharm 1<sup>st</sup>Year: 2<sup>nd</sup>Semester

**Course Title: Pharmaceutical Microbiology and Immunology- Lab**

**Course Code: PHARM 1205**

**Credit: 1**

1. Laboratory safety measures and aseptic techniques of transferring of microorganisms
2. Use of microscope and introduction to bacterial staining techniques.
3. Identification and characterization of bacteria
4. Staining of bacterial cells and spores
5. Preparation of bacterial media
6. Preparation of pure bacterial cultures
7. Isolation of bacteria from natural habitat
8. Preparation of pure culture and its identification
9. Bacterial counts
10. Identification and characterization of fungus
11. Isolation of pure culture by serial dilution method
12. Determination of bacterial growth curve
13. Different inoculation techniques of bacteria in nutrient agar.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 1<sup>st</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmacognosy and Phytochemistry- Lab**  
**Course Code: PHARM 1206**  
**Credits: 2**

1. The cell, cell contents and cell types.
  - i. The cell - (a) some cellular organism, chalk & diatomite. (b) Fungi- Mucor or rhizopus, aspergillus, penicillium, ergot and yeast.
  - ii. Cell contents – Starches and derivatives, calcium carbonate, silica.
  - iii. Cell types – Parenchyma and modifications – colocynth, nux-vomica, endosperm, cinnamon powder, tea, labiatae stem, parenchyma-pericyclic fibres jute, xylem fibres 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. Study of some medical and poisonous plants of Bangladesh.
5. Pharmacognostic study of a few selected powdered drugs.
6. Chromatographic techniques: analysis of plant extracts by thin layer chromatography.
7. Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.
8. Detection of adulterants, (i.e. cotton seed, sesame and arachis oils) in olive oil.
9. Examination of Cod liver oil and detection of vitamin A in Cod liver oil.
10. Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.
11. Isolation of lycopene from tomato.
12. Isolation of  $\beta$ -Carotene from carrot.
13. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.
14. Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.
15. Study of alkaloids and some alkaloid containing drugs: Belladonna, Stramonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nux vomica and Areca.
16. Isolation of lactose from Cow's milk.
17. Physical and chemical tests for honey.
18. Extraction and tests of alkaloids, lipids etc.
19. Test of tannins.

N.B. The course can be designed/modified according to the course teacher.

**Course Title: Viva voce**  
**Course Code: PHARM 1207**  
**Credit: 1**

Every student must give a Viva voce at the end of B. Pharm Year I. Topics of the Viva voce will cover from any course of Semester-1 and Semester-2 and current affairs of Pharmaceuticals.

**B. Pharm 2<sup>nd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutics-I**  
**Course Code: PHARM 2101**  
**Credits: 3**

**1. Pharmaceutical Excipients:** Chemistry, physical properties and uses of antimicrobial preservatives, acidifying agents, alkalizing agents, antioxidants, buffering agents, complexing agents, suspending agents, emulsifying agents, air displacement agents, antifoaming agents, humectants, ointment bases, coloring agents, flavoring agents, solvents and co-solvents stiffening agents, wetting and solubilizing agents.

**2. Liquid Dosage Forms:** Various liquids for external, oral and paranteral use, Clear liquids and solutions- physicochemical considerations, types of solution dosage form, solution and elixirs, theory of solution, different factors affecting solution process, advantages and disadvantages, formulation and manufacturing considerations, additives, solubilizers, colors, flavors and other excipients that are used in formulations, packaging of liquids, preservation and stability aspects and quality control systems of liquids.

**3. Dispersed System:**

**a) Properties of Dispersed Systems:** Theoretical aspects of suspension, emulsion and colloids, interfacial properties of suspended particles, surface charge activities and zeta potential, theory of sedimentation, effect of Brownian movement, suspending and emulsifying agents, Inter- particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence.

**b) Suspension:** Definition and application, advantage and disadvantages, aggregated and dispersed system, formulation, manufacturing and stability, evaluation and quality control, rheological consideration, illustrative examples.

**c) Emulsion:** Definitions and applications, advantage and disadvantages, classification of emulsion, theory of emulsion, formation of emulsion, classification of emulsifying agents, HLB values of surface active agents, formulation manufacturing, stability and evaluation, rheological considerations.

**4. Semisolids (Ointments, Paste, Gels, etc.):** Structure of skin, percutaneous absorption of drugs, factors influencing penetration of drug thorough skin, definition and classification of semisolid, classification of ointment bases, formulation and manufacturing of ointments, pastes and gels, rheological considerations, evaluation and quality analysis.

**Recommended Books:**

1. A. Martin and J. Swarbrick : Physical Pharmacy
2. E. W. Martin : HUSA's Pharmaceutical Dispensing
3. E. A. Rawlins : Bentley's Textbook of Pharmaceutics

4. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy
5. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Inorganic Chemistry-II**  
**Course Code: PHARM 2102**  
**Credits: 3**

- 1. Hematinic Preparations:** Various types of iron and iron compounds, role of iron compounds in hematological crisis, official iron compounds.
- 2. Pharmaceutically Acceptable Glass and water:** (i) Various types of glass, advantages and disadvantages, problems regarding glassware in pharmaceuticals. (ii) Water: Hardness of water, treatment of natural water- distilled water, demineralized water, and official waters.
- 3. Topical Agents:** Official agents used in different dermatological conditions—protectives, antimicrobial agents- hydrogen peroxide solution, potassium permanganate, boric acid, iodine preparations, sodium hypochloride solution, protein precipitants, astringent products.
- 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, mouthwash and desensitizing agents.
- 6. 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, Contrast Media- Barium sulfate, organoidine compounds.
- 7. Miscellaneous Agents:** Inhalants, respiratory stimulants, expectorants, emetics, antidotes, Pharmaceutical acids, bases, buffers, antioxidants, tableting aids-lubricants, ligands, etc.

**Recommended Books:**

1. Randy Hendrickson et. al. : Remington, The Science and Practice of Pharmacy
2. Block, Roche, Soine and Wilson : Inorganic, Medicinal and Pharmaceutical Chemistry
3. L. M. Atherden : Bentley and Driver's Textbook of Pharmaceutical Chemistry
4. H. S. Storker and S. L. Seager : Environmental Chemistry, Air and Water Pollution
5. Paragon press London : Roger's Inorganic Pharmaceutical Chemistry
6. Discher : Modern Inorganic Pharmaceutical Chemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Organic Chemistry-II**  
**Course Code: PHARM 2103**  
**Credits: 3**

- 1. A General Introduction of Heterocyclic Compounds:** Characteristic, properties and pharmaceutical importance of heterocyclic compounds: furan, thiophene, pyrrole, quinoline, isoquinoline, pyridine, thiazole, imidazole, pyrimidine, indole etc.
- 2. Stereochemistry:** A general treatment of different types of isomerism, tautomerism, asymmetric synthesis, Geometric isomerism of alkenes and other cyclic compounds, cis, trans and E, Z systems.
- 3. Reaction Mechanism:**
  - a) Addition reaction: Electrophilic, nucleophilic and free radical (1, 2 and 1, 4) addition.
  - b) Substitution reaction: Unimolecular and bimolecular.
  - c) Elimination reaction: Unimolecular and bimolecular.
  - d) Rearrangement reaction: Hoffman, Claisen, Sigmatropic and Fries rearrangement.
- 4. Name Reactions:** Arndt- Eisterd, Baklelite, Baeyer-Villiger, Birch reduction, Clemmensen reduction, Darzens condensation, Diels Alder, Eschweiler-Clarke, Friedel- Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Michael, Meerwin- Pondorf- Verley, Oppenauer oxidation, Perkin, Reformatsky, Reimer- Tiemann, Vilsmeier- Haack, Witting and Wolf-Kishner reduction.
- 5. Synthesis and Applications of Drugs:** Paracetamol, aspirin, phenacetin, para-amino benzoic acid (PABA) and sulph drugs.
- 6. 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, racimization etc.

**Recommended Books:**

1. Advanced Organic Chemistry - Arun Bhal, B.S. Bahl.
2. Organic Chemistry (Vol. 1&2) - I.L. Finer.
3. Organic Chemistry - R.T. Morrison & R.N. Boyd.
4. Organic Chemistry - T.W. Graham Solomons.

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Physical Pharmacy-I**  
**Course Code: PHARM 2104**  
**Credits: 3**

- 1. Chemical Equilibria:** Law of mass action, criteria of chemical equilibrium, application of law of mass action to homogenous and heterogeneous equilibrium, factors affecting equilibrium, Gibb's free energy change for chemical equilibria, Le-Chatelier principle and its industrial application, Vant Hoff equation.
- 2. Chemical Thermodynamics:** System, the first law of thermodynamics, work, energy, heat and enthalpy, work of expansion, internal energy, determination of internal energy, Second law of

thermodynamics, the concept of entropy and entropy changes, heat change at constant volume and constant pressure, reversible, irreversible, isothermal and adiabatic changes, molar heat capacity, difference between molar heats, Joule- Thomson experiment.

Fundamentals of thermochemistry: Exothermic and endothermic reactions, thermochemical equation, heat of reaction, Laplac's and Hess's laws and its applications, bond energies.

**3. Phase Equilibria:** Phase, components and degree of freedom, , phase rule of one and two component system, triple point, azeotrope mixture, critical solution temperature (CST), eutectic mixture, fractional distillation, freeze drying (lyophilization).

**4. 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. Colligative properties of dilute solution, osmotic pressure, measurement of osmotic pressure, coefficients for expressing colligative properties.

**5. Ionic Equilibria:** Modern theories of acids, bases and salts, Ionization of weak acids and bases, ionization constants of acid and bases, pH, Sorensen's pH scale, Henderson equation, titration curves of acid and bases, common-ion effect, indicators and the mechanism of their color change.

**6. Buffer and Isotonic Solutions:** Buffer solution, buffer equations, buffers in pharmaceutical and biological systems, buffer capacity, isotonic, hypertonic and hypotonic systems, dialysis, methods of adjusting tonicity and pH.

#### **Recommended Books:**

1. M. M. Haque and M. A. Nawab : Principles of Physical Chemistry
2. A. Martin and J. Swarbrick : Physical Pharmacy
3. P.W. Atkins : Physical Chemistry
4. K.K. Sharma and L.K. Sharma : A Textbook of Physical Chemistry
5. B.S. Bahl, D.G. Tuli and A. Bahl : Essentials of Physical Chemistry
6. N. Kundu and S.K. Jain : Physical Chemistry
7. S. H. Maron and C.F. Prutton : Principles of Physical Chemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup>Year: 1<sup>st</sup>Semester**  
**Course Title: Pharmaceutics-I- Lab**  
**Course Code: PHARM 2105**  
**Credit: 1**

1. Preparation of percentage solution.
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 suspension:
  - (a) Paracetamol suspension
  - (b) Antacid suspension
  - (c) Chalk powder suspension
5. Preparation of emulsion and determination of type of emulsion

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

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup>Year: 1<sup>st</sup>Semester**  
**Course Title: Pharmaceutical Inorganic Chemistry- Lab**  
**Course Code: PHARM 2106**  
**Credits: 2**

**1. Qualitative Analysis of Inorganic Ions and Radicals:**

Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>+2</sup>, Al<sup>+3</sup>, Mg<sup>+2</sup>, Fe<sup>+2</sup>, Mn<sup>+</sup>, Ag<sup>+</sup>, Cu<sup>+</sup>, Cu<sup>+2</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup> and, CO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>-2</sup>, NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>-3</sup> etc.

**2. Identification of Inorganic Ions from Pharmaceutical Formulations:** Ca<sup>+2</sup>, Fe<sup>+2</sup>, Al<sup>+3</sup>, Mg<sup>+2</sup>, K<sup>+</sup> and Na<sup>+</sup> ions from supplied preparations.

**3. 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.

**4. Preparation of Inorganic Drugs:**

- a) Preparation of aluminium hydroxide gel.
- b) Preparation of magnesium hydroxide.
- c) Preparation of haematinics- ferrous chloride, ferrous gluconate and ferrous fumarate.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup>Year: 1<sup>st</sup>Semester**  
**Course Title: Pharmaceutical Organic Chemistry- Lab**  
**Course Code: PHARM 2107**  
**Credits: 2**

- 1. Detection of elements (C, H, N, O, F, Cl, Br etc)
- 2. Identification of functional groups (OH<sup>-</sup>, CHO, NH<sub>2</sub>, NO<sub>3</sub>, CO, CHO, COOH, etc)
- 3. Test of purity
- 4. Solubility test and classification of the compounds.
- 5. Identification of organic compounds: Solids and liquids, detection and identification of impurities, tests for carbohydrates, proteins and fats.
- 6. Melting point determination of different unknown organic compounds.
- 7. Organic preparation involving typical reactions eg., Grignard reaction, Perkin reaction, Friedel craft reaction, esterification reaction.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup>Year: 2<sup>nd</sup>Semester**  
**Course Title: Biochemistry and Molecular Biology**  
**Course Code: PHARM 2201**  
**Credits: 3**

**1. Enzymes:** Nomenclature, chemistry, enzyme kinetics and its mechanism of action, mechanism of inhibition, isozymes and its clinical use, co-enzymes – vitamins as co-enzymes, chemistry of vitamins, their uses and significance, metals as co-factors and their significance.

**2. Carbohydrates:** The chemistry of carbohydrates, conversion of polysaccharides to glucose-1-phosphate, glycolysis and fermentation and their regulation, gluconeogenesis and glycogenolysis, metabolism of galactose and galactosemia, role of sugar nucleotides in biosynthesis and pentose phosphate pathways and other alternate pathway of carbohydrate metabolism, the citric acid cycle.

**3. Lipids:** The chemistry of lipids, oxidation of fatty acids, biosynthesis of saturated and unsaturated fatty acids, essential fatty acids and eicosanoids (prostaglandins, thromboxane), phospholipids, and sphingolipids.

**4. Proteins:** Definition, characteristics, chemical bonds, types and functions of protein. Amino acids and their classification, chemistry of amino acids, synthesis of amino acids, identification of amino acid, peptide synthesis. Protein structure, denaturation and renaturation of protein. protein separation and purification.

**5. Nucleic Acids:** Brief introduction of the genetic organization of the mammalian genome, alteration and rearrangements of genetic material, biosynthesis of DNA and its replication, mutation, physical and chemical mutagenesis, carcinogenesis, DNA repair mechanism, biosynthesis of RNA, genetic code, components of protein synthesis and inhibition of protein synthesis, Regulation of gene expression, purine and pyrimidine biosynthesis, replication and transcription and translation.

**Recommended Books:**

1. A. L. Lehninger : Principles of Biochemistry
2. Pamela C Champe, Harvey : Lippincott's Illustrated Reviews: Biochemistry
3. Robert K. Murray, et al : Harper's Illustrated Biochemistry
4. Jeremy M. Berg et al : Biochemistry
5. Satyanarayana : Biochemistry
6. Dawn B., D. Marks et al : Basic Medical Biochemistry: A Clinical Approach
7. Donald Voet & Judith Voet : Biochemistry
8. Donald Voet, et al : Fundamentals of Biochemistry: Life at the Molecular Level
9. Thomas M. Devlin : Textbook of Biochemistry with Clinical Correlations
10. Katherine J Denniston et al : General, Organic, and Biochemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Physiology and Anatomy-II**  
**Course Code: PHARM 2202**  
**Credits: 3**

**1. Nervous System:**

a) 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.

b) Reflex and reflex arc, their classifications, properties and components of reflex arc.

c) 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.

**2. Excretory System:** Structure and function of kidney, composition and formation of urine, renal circulation, renal regulation of acid base balance, renal diseases and kidney function tests, physiology of micturition, artificial kidney: basic principles, method and applications.

**3. Metabolism:** Fat, carbohydrate, protein and nucleoprotein metabolism; metabolic pathways of fats, carbohydrates and proteins; enzymes, vitamins and hormones regulating various metabolic steps.

**4. Endocrine System:** Introduction to different endocrine glands.

a) Pituitary glands: anterior and posterior pituitary glands, its function and disorders.

b) Thyroid glands: Structure, synthesis of hormone, control of secretion and their function, disorder to thyroid gland, thyroid function test.

c) Parathyroid gland: organization, secretion and function of hormone, Ca<sup>+2</sup> metabolism, and tetany.

d) Adrenal cortex: structure, biosynthesis of steroid hormones and their function, regulation of hormone secretion, disorder of adrenal cortex.

e) Adrenal medulla: Structure, biosynthesis of hormone, their function and regulation, disorder of adrenal medulla.

f) Islets of Langerhans of pancreas: function, secretion, and diabetes mellitus.

**5. Reproductive System:** Testis & accessory reproductive systems & their functions, male hormones and their functions, spermatogenesis and its hormonal regulation. Organs of female reproductive system and their functions, menstruation cycle, different phases & its regulation; ovogenesis & ovulation and its control; female sex hormones & their functions; pregnancy and lactation & their hormonal control.

**Recommended Books:**

1. C.C. Chatterjee : Human Physiology Vol. I & II
2. Guyton : A Textbook of Medical Physiology
3. Shahan et al. : Human Physiology
4. W. F. Ganong : Review of Medical Physiology
5. S. Wright : Applied Physiology
6. Selim Reza : The Essentials of Human Physiology

7. Stryer : Biochemistry  
8. Lehninger et al.: Principles of Biochemistry  
9. A.C. Dev : Fundamental of Biochemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup>Year: 2<sup>nd</sup> Semester**  
**Course Title: Physical Pharmacy-II**  
**Course Code: PHARM 2203**  
**Credits: 3**

**1. Reaction Kinetics and Stability of Pharmaceuticals:**

**a) Chemical Kinetics:** General consideration and concepts, rates and orders of reactions, methods for determination of orders of reactions, half life determination; factors affecting reaction rates -influence of temperature, humidity, light, solvent, catalytic species and other factors.

**b) Physical Degradation of Pharmaceutical Products:** Loss of water, absorption of water, loss of volatile constituents, polymorphism, color change.

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

**d) Stability of Pharmaceuticals:** Accelerated test for physical, chemical and photochemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination, expiration dating.

**2. Surface and Interfacial Phenomenon:** Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, adsorption at solid and liquid interfaces, complex films, electrical properties of interface, electrical double layer, Nernst and zeta potential, Gibb's equation, spreading, characteristics of adsorption, application of adsorption in pharmacy.

**3. Surface-active Agents:** Classifications of surfactants, emulgents, detergents and antifoaming agents, mechanism of actions and their uses in pharmacy.

**4. Micrometrics and Powder Rheology:** Particle size and distribution, Importance of particle size determination, average particle size, number and weight distribution, particle number, method of determining particle volume- optical and electron microscope studies, coulter counter methods, laser beam technique, sieve analysis, sedimentation methods; particle shape, specific surface, determination of surface area, permeability, derived properties of powder, porosity, packing arrangements, density, bulkiness and flow properties.

**5. Viscosity and Rheology:** Newtonian systems, Law of flows, basic equation of fluid flow, kinematics viscosity, effect of temperature, non-Newtonian system: pseudoplastic, dilatant and plastic flows, yield value, thixotropy, thixotropy in a formulation, determination of viscosity, measurement of flow and pressure and Reynolds number.

**6. 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.

**7. Electrochemistry:**

**a)** Electrical units and their interrelation, Faradays laws of electrolysis and electrochemical equivalents, conductance of electrolytes, concept of E. M. F and its measurements, electrode, various types of electrochemical cells, relation between electrical and chemical energies, oxidation-reduction systems, solutions of electrolytes.

b) Electrochemical cells and cell reactions, electrode and cell potentials, energies involved in electrode processes; reference electrodes, concentration cell, stoichiometry of electrolysis, electrochemistry and biological cell potentials.

**Recommended Books:**

1. M. M. Haque and M. A. Nawab : Principles of Physical Chemistry
2. A. Martin and J. Swarbrick : Physical Pharmacy
3. Gordon M. Barrow : Physical Chemistry
4. C.V.S. Subrahmanyam : Textbook of Physical Pharmaceuticals
5. S. P. Agarwal and Rajesh Khanna : Physical Pharmacy
6. S. Glasstone and D. Lewis : Elements of Physical Chemistry
7. N. Kundu and S.K. Jain : Physical Chemistry
8. K. J. Laidler : Chemical Kinetics

\* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Applied Microbiology**  
**Course Code: PHARM 2204**  
**Credits: 2**

**1. Microbial Assay of Antibiotics:** Antimicrobial activity, factors affecting the measurement of antimicrobial activity, antibiotic assays, biological and non biological assays, determinations of MICs (Minimum Inhibitory Concentrations), challenge tests, microbiological quality of pharmaceutical materials with special reference to non-sterile and sterile products, t- test.

**2. Sterilization**

a) Sterilization by dry heat- principle, hot air oven, applications, advantages and disadvantages of sterilization by moist heat, factors affecting sterilization by moist heat, principle of sterilization by steam under pressure, autoclave- applications, testing the efficiency of autoclaves, sterilization by heating with bactericides, validation of sterilizers.

b) Sterilization by filtration

c) Sterilization by radiation

d) Sterilization by gas

**3. Sterility Testing:** Sampling techniques, types of media used in sterility testing, positive and negative controls, pyrogen tests, testing procedure for aqueous solutions, aqueous suspensions, powders, semi solid preparations, oils and ointments, ligatures and sutures, surgical dressings, equipments; miscellaneous tests- immunological preparations and viral products.

**4. Disinfectant, Antiseptics and Preservatives:** Introduction to disinfectant, factors influencing disinfectant, chemical disinfectants, and their modes of action, disinfectant evaluation. Manufacture of alcoholic beverages and enzymes of medical importance.

**5. Industrial Microbiology:** Ecology of microorganisms affecting pharmaceutical industry, microbial spoilage and preservation of pharmaceutical products, pharmaceutical products made by genetic engineering, miscellaneous pharmaceutical products of microbial origin (vitamins, amino acids, dextran, etc.), streptokinase.

**.6. Bacterial Resistance.**

**Recommended Books:**

1. M.J. Pelczar, E.C.G. Chan and N.R. Kreig : Microbiology
  2. Tortora, Funke : Microbiology Introduction
  3. Stainer, Ingraham, Wheelis and Painter : General Microbiology
  4. Salle : Fundamental Principles of Bacteriology
  5. R. Ananthanarayan and C. K. J. Paniker : Textbook of Microbiology
  6. M. R. Choudhury : Modern Medical Microbiology
  7. Ivan Roitt, J. Brostoff and David Male : Immunology
  8. Abul K. Abbas, A.H. Lichtman : Cellular and Molecular Immunology
  9. W.H. Elliott and D.C. Elliott : Biochemistry and Molecular Biology
  10. S. J. Carter : Cooper and Gunn's Tutorial Pharmacy
  11. Samuel Cate Prescott, Cecil Gordon Dunn : Prescott and Dunn's Industrial Microbiology
- \* Other Books will be indicated by respective teachers.

**B. Pharm 2<sup>nd</sup>Year: 2<sup>nd</sup>Semester****Course Title: Biochemistry and Molecular Biology- Lab****Course Code: PHARM 2205****Credit: 1**

1. Determination of protein content 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, SGOT levels in blood.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup> Year: 2<sup>nd</sup> Semester****Course Title: Physiology and Anatomy- Lab****Course Code: PHARM 2206****Credits: 2**

1. Measurement of blood pressure.
2. Total count of R.B.C.
3. Total count of W.B.C.
4. Differential count of W.B.C.
5. Determination of clotting and bleeding time.
6. Determination of blood group.
7. Estimation of hemoglobin.
8. Recording of normal heart beat in toad
9. Demonstration of the effects of temperature aviation on toad heart

10. Demonstration of the effects of stannous ligatures on toad heart
11. Demonstration of the effects of drugs on toad heart
12. Demonstration of the effect of Electrolytes ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^+$ ) on toad heart.
13. Recording of respiration with stethograph.
14. Determination of ESR (Erythrocyte Sedimentation Rate).
15. Determination of Packed Cell Volume (PCV).
16. Recording of body temperature and effect of exercise on it.
17. Effect of different posture on blood pressure.
18. Collection of gastric juice; test for gastric acidity

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup>Year: 2<sup>nd</sup>Semester**  
**Course Title: Physical Pharmacy- Lab**  
**Course Code: PHARM 2207**  
**Credit: 2**

1. Standardization of acids and bases.
2. Determination of  $\text{pK}_a$  and  $\text{pK}_b$  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.
8. 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 or Engler's viscometer.
9. Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/ NaOH.
10. Determination of adsorption isotherm of oxalic (or acetic) acid from aqueous solution by charcoal and calculation of the constant in Freundlich's equation.
11. Determination of the equilibrium constant of the reaction  $\text{KI} + \text{I} = \text{KI}_3$ .
12. Determination of solubility of a sparingly soluble salt in water by conductance measurement.
13. Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurements.
14. Determination of the molecular weight of an organic solid.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 2<sup>nd</sup>Year: 2<sup>nd</sup> Semester**  
**Course Title: Viva voce**  
**Course Code: PHARM 2208**  
**Credits: 1**

Every student must give a Viva voce at the end of B. Pharm Year II. Topics of the Viva voce will cover from any course of Semester-3 and Semester-4 and current affairs of Pharmaceuticals.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Analysis-I**  
**Course Code: PHARM 3101**  
**Credits: 3**

**1. Introduction to Pharmaceutical Analysis:** Significance of quantitative analysis in pharmaceutical quality assurance, different techniques of analysis, selection of samples, significant figures, Collection of data, tabulation and graphical representation of data, precision and accuracy of representative samples.

**2. Titrimetric Analysis:**

**a) Aqueous Acid-Base Titrations:** Definitions, distribution of acid base species with pH of the medium, acid-base titration for determination of acidic and basic pharmaceuticals. Indicators: theories, selection and applications.

**b) Oxidation-Reduction Titrations:** Principles and concepts, determination involving potassium permanganate, potassium dichromate and potassium bromide. Iodimetric and iodometric determination, miscellaneous oxidation and reduction titrations, indicators and applications.

**c) Complexometric Titrations:** Introduction, complexes and chelates, stability of complex ions, titrations based on complex formation, types of complexometric titrations, technique employed in chelometric titration, methods of end point detection, titration selectivity and masking reagents.

**d) Non-aqueous Acid Base Titrations:** Theoretical considerations and principles of Bronsted-Lowry theory of acids and bases, non aqueous solvents, titration of weak acids and weak bases, applications and scope of non aqueous titration.

**3. 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 limitation.

**4. Polarimetry:** Introduction, instrumentation and application, optical isomerism, origin of optical rotation, molecular requirements for optical rotatory power, specific rotation, calculation of specific rotation, circular dichroism (CD), optical rotatory dispersion (ORD).

**5. Potentiometric Titration:** Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, application of potentiometric titration.

**Recommended Books:**

1. A.H. Beckett, and J. B. Stenlake : Practical Pharmaceutical Chemistry Vol. I & II
2. K. A. Connors : A Textbook of Pharmaceutical Analysis
3. L.G. Chatten : Pharmaceutical Chemistry Vol. I & II
4. A.M. Knevel and F.E. DiGangi : Jenkins Quantitative Pharmaceutical Chemistry
5. T. Higuchi and E. Brockman-Hanssen : Pharmaceutical Analysis
6. A. I. Vogel : Textbook of Quantitative Analysis
7. V. Alexeyev : Quantitative Analysis
8. Douglas A Skoog : Principles of Instrumental Analysis

9. B.K. Sharma : Instrumental Methods of Chemical Analysis  
10. R.M. Verma : Analytical Chemistry, Theory and Practice

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Medicinal Chemistry-I**  
**Course Code: PHARM 3102**  
**Credits: 3**

**1. Stereochemistry:**

- a) Conformational isomers- conformation of open chain and cyclic compounds.
- b) Chirality of molecules- enantiomer, diastereomer, racemic modification, meso compound, (R) and (S) configuration, sequence rule, optical rotation.
- c) Asymmetric synthesis- preparation of enantiomer by asymmetric synthesis and optical resolution method.
- f) Stereoselective and stereospecific reaction.
- g) Pharmaceutical importance of stereochemistry

**2. Heterocyclic Chemistry:**

- a) 5-membered heterocyclic compounds: Pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole and Isothiazole- their preparations and pharmaceutical applications.
- b) 6-membered heterocyclic compounds: Pyridine, piperidine, pyrimidine, pyridazine, pyrazine and triazine: their preparation and pharmaceutical applications.
- c) Benzofused 5-membered heteroatomic compounds: Indole, benzofuran, benzothiaphene and carbazole- their synthesis and pharmaceutical applications.
- d) Benzofused 6-membered heteroatomic compounds: Quinoline and isoquinoline- their synthesis and pharmaceutical applications.

**3. Chemistry, SAR, Mode of Action and Synthesis of the Following Groups of Drugs:**

- a) Sedatives & Hypnotic agents: Benzodiazepines, Barbiturates.
- b) Antihistamines: H<sub>1</sub> and H<sub>2</sub> antagonists.
- c) NSAID: Indomethacin, Ibuprofen, Naproxen, Probenecid, Phenacetin, Phenylbutazone, Mefenamic Acid.
- d) Cardiovascular Drugs: Hydralazine, Propranolol, Prenylamine.
- e) Diuretics: Chlorothiazide, Acetazolamide, Triamterene.

**Recommended Books:**

- 1. Wilson and Gisvold : Textbook of Organic, Medicinal and Pharmaceutical Chemistry
- 2. Ashutosh Kar : Medicinal Chemistry
- 3. Graham L. Patrick : Cooper and Gunn's Dispensing for Pharmaceutical Students
- 4. Alfred Burger : Medicinal Chemistry Vol. I & II
- 5. E. J. Ariens : Drug Designs Vol. I, II & III
- 6. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II
- 7. W.O. Foye : Principles of Medicinal Chemistry

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Biopharmaceutics-1**  
**Course Code: PHARM 3103**  
**Credits: 3**

**1. Introduction to Pharmaceutics and Biopharmaceutics.**

**2. Gastrointestinal Absorption of Drugs:**

- a) Biological Consideration: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.
- b) Physicochemical Consideration: pKa and gastrointestinal absorption, pH-partition theory and other physicochemical factors.
- c) Dosage form consideration: Role of different dosage form like solution, suspension, tablet, capsule, emulsion etc. on gastrointestinal absorption.
- d) Diffusion and disintegration: Steady state diffusion, procedure & apparatus, transport of drug across GIT, diffusion controlled release- Higuchi's equation, diffusion principle in biological systems.
- e) Dissolution of drugs: Dissolution rate, Hixson-Crowell Cube Root Law, factors influencing dissolution, dissolution test apparatus, in-vitro & in-vivo correlations of dissolution, drug release patterns.

**3. Distribution of Drugs:**

- a) Important Pharmacokinetic Parameters: Biological half-life, apparent volume of distribution, area under the curve, absorption and elimination rate constant etc.
- b) Interpretation of drug-plasma level curve.
- c) Drug-Protein Interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of 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 reabsorption. c) Determination of renal clearance.
- d) Biotransformation of Drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michaelis Menten equation), hepatic elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance).
- e) Biliary excretion of drug.

**5. Study of Prodrugs:** Applications and limitations of prodrug designs

**Recommended Books:**

- 1. Leon Shargel and Andrew B : Applied Biopharmaceutics and Pharmacokinetics
- 2. Milo Gibaldi : Biopharmaceutics and Clinical Pharmacokinetics

3. Donald E. Cadwallader : Biopharmaceutics and Drug action
4. Bourne, Triggs and Eadie : Pharmacokinetics for the Non-mathematical

\* Other Books will be indicated by respective teachers.

### **B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Pharmacology-I**

**Course Code: PHARM 3104**

**Credits: 3**

**1. Introduction to Pharmacology:** Definition of pharmacology, drug, medicine and pro drug; pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, drug interaction, drug tolerance, drug dependence, drug abuse, idiosyncrasy, dose, dosage form, absorption, distribution, bioavailability, distribution, protein binding, metabolism & excretion, routes of drug administration.

**2. Basic Concept of Drug Action:** Definition of drug action, different mechanisms of drug action, receptors, nature of receptors, drug antagonism, relation between drug dose & clinical response.

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

**4. Drug Metabolism:** Various pathway of drug metabolism, metabolism of various group of drugs, factors affecting drug metabolism with special emphasis on aging, methods of studying drug metabolism, new aspects of drug metabolism.

**5. Drugs for Peptic Ulcer:** General consideration, chemistry, absorption, modification, distribution and excretion. Antacids, H<sub>2</sub> - receptor blockers, proton pump inhibitors, PG analogues, mucosal-protective agents.

#### **Recommended Books:**

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II
2. H. P. Rang, M. M. Dale, J. M. Ritter : Pharmacology
3. K. D. Tripathi : Essentials of Medical Pharmacology
4. R. A. Harvey and P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology
5. Andres Goth : Medical Pharmacology
6. B. G. Katzung : Basic and Clinical Pharmacology
7. R. S. Satoskar and S. D. Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II

\* Other Books will be indicated by respective teachers.

### **B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Pharmaceutical Biotechnology**

**Course Code: PHARM 3105**

**Credits: 3**

- 1. Introduction of Biotechnology:** History and different dimension of biotechnology, application of biotechnology in medicine, foods, forensic science, microbial and plant genetics.
- 2. Fermentation Technology:** Introduction to fermentation technology, improvement of industrial strains of microorganisms, fermentative, medium and inoculum development, biological products obtained from fermentation.
- 3. Recombinant DNA Technology and Production of Biotech Compounds:** Basic principle, genetic recombination- cloning, gene expression, restriction endonuclease, ligase and other enzymes used in gene cloning, cloning vectors, transfection method, knock out and transgenic animals, cultivation and downstream processing, issues to consider in production and purification of proteins.
- 4. Immunology:** Monoclonal antibody, hybridoma technology, basic principles of immunology, antigen and haptens, vaccines.
- 5. Gene Therapy:** Ex vivo versus in vivo gene therapy, potential target diseases for gene therapy, gene transfer methods, and non-viral gene transfer.
- 6. Enzyme Immobilization and application.**

#### **Recommended Books:**

1. W.H. Elliott and Daphne C. Elliott : Biochemistry and Molecular Biology
2. S.P. Vyas and V.K. Dixit : Pharmaceutical Biotechnology
3. K. Sambamurthy and A. Kar : Pharmaceutical Biotechnology
4. W. Crueger and A. Crueger : Biotechnology, A Textbook of Industrial Microbiology
5. Michael J. Groves : Pharmaceutical Biotechnology
6. Daan J. A. et al. : Pharmaceutical Biotechnology
7. Lirikjian Su : Biotechnology Theory and Techniques.

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Law and Ethics**  
**Course Code: PHARM 3106**  
**Credits: 3**

- 1. Regulations and laws governing the practices of pharmacy in Bangladesh:** (The Pharmacy Ordinance 1976), role of Pharmacy Community of Bangladesh, the role of pharmacists in operating and maintaining model pharmacy and model medicine shops.
- 2. The Pharmacist's code of ethics.**
3. An introductory study on the Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons in Bangladesh (with latest amendments):  
 The Drug Act 1940 (XXIII of 1940)  
 The Drug Ordinance 1982  
 The National Drug Policy 1982  
 The Drug (Control) Ordinance 1982 (Ordinance No. VIII of 1982), its amendments; Drug Control Ordinance 2006  
 The Narcotics (control) Act 1990

The National drug policy 2005 and 2016 for regulation of process of registration, manufacture, distribution, sale, import, and export of drug in Bangladesh.

The Poisons Act 1919 and related amendments.

**4. cGMP of Pharmaceutical manufacturing:** · Evolution and Principles of cGMP, Schedule-M, WHO-GMP requirements, European Union (EU) and United States Food and Drug Administration (USFDA) guidelines on Pharmaceutical manufacturing.

**Recommended Books:**

1. Pharmacy Ordinance 1976 : Ministry of Law and Parliamentary Affairs, Govt. of Bangladesh
2. The Drugs (control) Ordinance : Ministry of Law and Land Reforms, Government of Bangladesh
3. Drug Policy of Bangladesh : Ministry of Health and Population Control, Govt. of Bangladesh

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Pharmaceutical Analysis-I- Lab**

**Course Code: PHARM 3107**

**Credit: 2**

1. Assay of acetyl salicylic acid in aspirin tablets.
2. Assay of sodium salicylate tablets.
3. Determination of potency of penicillin tablets.
4. Non- aqueous assay of phenobarbitone tablets.
5. Determination of calcium in solid & liquid dosage form by complexometric titration.
6. Assay of promethazine hydrochloride.
7. Assay of methamphetamine hydrochloride.
8. Assay of aluminum hydroxide gel.
9. Assay of milk of magnesia.
10. Assay of magnesium and aluminum from antacid preparation.
11. Determination of potency of penicillin tablets.
12. Determination of potency of vitamin tablets.
13. Determination of iodine value, saponification value, acid value and R.M. value of oils and fats.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Medicinal Chemistry-I- Lab**

**Course Code: PHARM 3108**

**Credit: 2**

**Laboratory synthesis, physical, chemical and spectral characterization of the following Compounds:**

1. Paracetamol
2. Benzocaine
3. Aspirin
4. Phenacetin
5. PABA (para amino benzoic acid)
6. Meta nitro benzaldehyde
7. Ethyl para hydroxy benzoate
8. Para amino phenol
9. Methyl salicylate.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 3<sup>rd</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmacology-I- Lab**  
**Course Code: PHARM 3109**  
**Credit: 1**

1. Handling of experimental animals: mice and rat.
2. Different routes of administration of drugs in experimental animals.
3. Study of drugs acting on CNS
  - a) CNS stimulant drugs (strychnine, ephedrine, amphetamine).
  - b) CNS depressant drugs (barbiturates induced sleeping time).
4. Effect of pilocarpine on saliva secretion of rat.
5. Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toads heart.
6. Effect of local anesthetics on rats tail.
7. Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine, physostigmine etc.).
8. Diuretic effect of Furosemide.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutics -II**  
**Course Code: PHARM 3201**  
**Credits: 3**

1. **Pre-formulation:** Preliminary evaluation and molecular optimization, bulk characterization of the material crystalinity 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. **Formulation and Manufacturing of Tablets:** Advantages and classification of tablets, formulation and granulation of powders for tableting, manufacturing of tablets by wet granulation, dry granulation and by direct compression, different types of tablet compression machinery and equipment.

**3. Common Tableting Problems and Evaluation of Tablets:** Hardness measurement, weight variation tests, thickness and diameter, friability, disintegration time, dissolution time, mechanism of tablet disintegration and dissolution, in process quality control methods in tablet manufacturing, study of common tableting problems and their solution.

**4. Compaction and Compression of Powder:** Physics of tablet compression, mechanism of tablet formation, bonding to tablets, the effect of compressional force on tablet properties, effect of lubricants on tablet compression and binding, factors affecting the strength of tablet, mechanism of bonding to tablets, instrumented tablet machines and tooling, problems associated with large scale manufacturing of tablets.

**5. Tablet Coating:** Definitions and classification of coating methods, advantages and disadvantages of coated tablets, different methods of coating- sugar coating, different stages of sugar coating, problems of sugar coating; film coating- theory of film coating, film formers, plasticizer, solvents, 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.

**6. Suppositories:** Drug absorption from colon, Ideal requirements of suppositories, advantages & disadvantages, classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, packaging and testing of suppositories.

#### **Recommended Books:**

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

\* Other Books will be indicated by respective teachers.

## **B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**

### **Course Title: Pharmacology-II**

**Course Code: PHARM 3202**

**Credits: 3**

#### **1. Autacoids:**

- a) Histamines: Mode of action, anaphylactic shock, histamine-releasing drugs, allergic disorder.
- b) Antihistamines: Classification, pharmacological, therapeutic uses, adverse reactions, etc.
- c) Serotonin and serotonin antagonists, prostaglandins, prostacyclins and thromboxane.
- d) The kinins: Kallidins and bradykinin.

#### **2. Analgesic, Antipyretic and Antinflammatory drugs:**

- a) Non-narcotic analgesic
- b) Narcotic analgesics

**3. Drugs Used in Haematopoietic System:** (a) Anticoagulants: Heparin, calcium complexing agents, oral anticoagulants. (b) Haematinic drugs: Iron, vit B12, folic acid, Erythropoietin

**4. Chemotherapy of Parasites:** Drugs used in helminthiasis, malaria, amebiasis.

**5. Drug Acting on Autonomic Nervous System:**

a) (i) Parasympathomimetic agents: Acetyl choline, Methacoline, Carbachol. (ii) Sympath-omimetic drugs: Epinephrine, norepinephrine. (iii) Anticholinesterase agents: Physostigmine, Edrophonine.

b) (i) Antimuscarinic Agents or Atropine Drugs (ii) Drugs inhibiting adrenergic nerves, adrenergic blocking agents.

c) Ganglion Stimulating and Blocking Agents.

**Recommended Books:**

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II

2. H. P. Rang, M. M. Dale : Pharmacology

3. K. D. Tripathi : Essentials of Medical Pharmacology

4. R. A. Harvey, P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology

5. Andres Goth : Medical Pharmacology

6. B. G. Katzung : Basic and Clinical Pharmacology

7. R. S. Satoskar and Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Biopharmaceutics-II**  
**Course Code: PHARM 3203**  
**Credits: 3**

**1. Compartmental Analysis:** Introduction:

a) One compartment open model, determination of plasma concentration from one compartment open model, calculation of apparent volume of distribution, calculation of K from urinary excretion data.

b) Multiple-Compartment models: i) Two compartment open model, method of residuals, apparent volumes of distributions, drug in tissue compartment, elimination rate constant ii) Three compartment open model: method of residuals, determination of area under curve, apparent volumes of distribution, elimination rate constant.

**2. Pharmacokinetics of Drug Absorption:** Zero-order absorption model, first-order absorption model, determination of absorption rates constant from oral absorption data: method of residuals, Wagner Nelson method, and determination of  $k_a$  from Urinary data and Loo Riegelman method, significance of absorption rate constant.

**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. Bioavailability and Bioequivalence:** Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute to bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies, method and determination of bioavailability.

**Recommended Books:**

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

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester****Course Title: Clinical Pathology****Course Code: PHARM 3204****Credits: 3**

**1. General Adaptation, Cell Injury and Cell Death:** Hyperplasia, hypertrophy, atrophy, metaplasia, necrosis, apoptosis, intracellular accumulation, pathological calcification.

**2. Acute & Chronic Inflammation:** Vascular changes, leukocyte extravasation & phagocytosis, chemical mediators, causes of chronic inflammation.

**3. Tissue Renewal, Regeneration and Repair:** Control of normal cell proliferation and tissue growth, cell cycle and the regulation of cell replication, mechanisms of tissue and organ regeneration, extracellular matrix and cell-matrix interactions, healing by repair, scar formation and fibrosis.

**4. Diseases of the Immune System:** The normal immune response- innate and adaptive immunity, components of the immune system- cells, tissues, and selected molecules, hypersensitivity and autoimmune disorders, rejection of tissue transplants, immunodeficiency syndromes, amyloidosis.

**5. Neoplasia:** Characteristics, grading and stages of cancer, metastasis, karyotype changes in tumour, carcinogenic agents and their cellular interaction, oncogenes and cancer, sarcomas.

**6. Infectious Diseases:** Categories of infectious agents, special techniques for diagnosing infectious agents, new and emerging infectious diseases, agents of bioterrorism, transmission and dissemination of microbes, how microorganisms cause disease, viral infections, bacterial infections, fungal infections, parasitic infections.

**Recommended Books:**

1. Kumar, Abbas and Fausto : Robbins and Cotran Pathologic Basis of Disease
2. Russell J Greene, Norman D Harris : Pathology and Therapeutics for Pharmacists
3. Ursus-Nikolaus Riede, Martin Werner : Color Atlas of Pathology

\* Other Books will be indicated by respective teachers.

## **B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**

**Course Title: Pharmaceutical Marketing and Management**

**Course Code: PHARM 3205**

**Credits: 3**

### **A. Pharmaceutical Marketing**

- 1. Basics of Marketing:** Needs, wants and demands; product, value, cost, satisfaction; exchange, transaction and relationship; markets, marketing and marketers.
- 2. Production, Product, Selling and Marketing Concepts:** Marketing process- selecting marketing opportunities, targeting the market, product positioning, formulating marketing strategy and plans, organizing, and implementing and controlling marketing efforts.
- 3. Pharmaceutical Marketing Environments:** Demographic factor, competitive factors, social and cultural factors, technology, government and legal factors.
- 4. Market Segmentation:** Necessity of market segmentation, therapeutic market, OTC market, wholesale market, and government market, foreign market.
- 5. Formulation of Marketing Strategies and New Product Launches:** Establishing competitive edge, product differentiation, service differentiation, product positioning, medical treatment problems. Screening, business and medical analysis, organizing launching program.
- 6. Product Life Cycle of Pharmaceutical Products:** Marketing strategies in different stages, marketing strategies of market challengers, market followers, market leaders.

### **B. Pharmaceutical Management**

- 1. Managerial Role of Pharmacists:** Pharmacists in different services of health and pharmaceutical industry- pharmaceutical production and quality control, marketing and sales, regulatory affairs, training, medical information services, research and development, hospital pharmacy, community pharmacy, NGOs, education consultancy.
- 2. Management, Planning and Organizing:** Nature and purpose of management, managerial function, role and skill; social responsibility and ethics of pharmaceutical managers. Nature, types of plans, planning steps and processes, decision making in different environments. Process of organizing, organizational structure, line and staff concepts, delegation.
- 3. Staffing and Controlling:** Recruitment process and technique, training and development.
- 4. Pharmaceutical Finance Affairs:** Concept, goals and scope of finance, relationship of managerial finance with pharmacy.
- 5. Pharmacoeconomics:** Definition, importances and types of pharmacoeconomics, relationship of pharmacoeconomics to market research.

### **Recommended Books:**

1. Rickey W. Griffin : Management
2. Philip Kotler : Marketing Management: Analysis, Planning, And Control

3. R. M. Mehta : Pharmaceutical Industrial Management
4. Anne Clayton : Insight into a Career in Pharmaceutical Sales
5. Carole Moussalli : Career Guide to Pharmaceuticals Sales
6. Mick Kolassa, Greg, Perkins : Pharmaceutical Marketing: Principles, Environment, and Practice
7. Harry A. Smith, S. J. Coons : Marketing Pharmaceutical Services: Patron Loyalty, Satisfaction, and Preferences
8. John E. Boyle, Emanuel Kay : Effective Field Sales Management
9. Sharon Srodin : Using the Pharmaceutical Literature
10. Tom Blackett, R. Robins : Brand Medicine: The Role of Branding in the Pharmaceutical Industry.

\* Other Books will be indicated by respective teachers.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutical Regulatory Affairs**  
**Course Code: PHARM 3206**  
**Credit: 3**

**1. Regulatory requirements for new product approval:**

Regulatory requirements for product approvals obtaining New Drug Application (NDA), Abbreviated New Drug Application (ANDA) for generic drugs, regulatory inspection system, Approval process, format and registration of Active Pharmaceutical Ingredients, Biologics, Novel therapies, special categories in Bangladesh, stability study, BE study, validation & qualification

2. Control of drug advertisements and prices, patented and trademarked medicine, proprietary medicine, regulation of cosmetics and poison control.

**3. Harmonization of regulatory requirements:** The International Conference on Harmonization (ICH) process, guidelines to establish quality, safety and efficacy of drug substances and products. Study of ICH common technical documents (CTD), harmonization of pharmacopoeial standards The International Organization for Standardization (ISO) 9000 series of quality systems standards, ISO 14000, licensing of premises.

**4. Globalization of drug industries:** Export import policy of drugs, WHO –certification, Trademarks, copyrights and patents, vendor qualification, post marketing surveillance.

**5. Overview of ICH guideline.**

**6. Pharmacovigilance and Antibiotic Policy**

**Recommended Books:**

2. The Drugs (control) Ordinance : Ministry of Law and Land Reforms, Government of Bangladesh
3. Drug Policy of Bangladesh : Ministry of Health and Population Control, Govt. of Bangladesh
4. Textbook of Forensic Pharmacy : B.M. Mithal.
5. Pharmacist's Code of Ethics : Pharmacy Council of Bangladesh.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutics-II- Lab**  
**Course Code: PHARM 3207**  
**Credit: 1**

1. Formulation and compounding of different syrups.
2. Formulation and compounding of different suspensions.
3. Formulation and compounding of different emulsions.
4. Formulation and compounding of ointments.
5. Study of different components of a 16-station rotary table press.
6. Formulation and manufacturing of antihistamine tablets.
7. Formulation and manufacturing of dispersible aspirin tablet.
8. Formulation and manufacturing of some capsule dosage form.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmacology-II- Lab**  
**Course Code: PHARM 3208**  
**Credit: 1**

1. Estimation of blood glucose by enzymatic method.
2. Estimation of blood glucose by chemical method.
3. Estimation of glucose in blood in normal condition and after administration of insulin.
4. Estimation of plasma protein by enzymatic method.
5. Estimation of plasma protein by Biuret method.
6. Estimation of blood uric acid level by enzymatic method.
7. Estimation of cholesterol in human blood by enzymatic method.
8. Estimation of cholesterol in human blood by chemical method.
9. Spectrophotometric estimation of blood pigments.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Biopharmaceutics- Lab**  
**Course Code: PHARM 3209**  
**Credits: 2**

1. Tablet weight variation test.
2. Tablet hardness test.
3. Tablet friability test.
4. Disintegration test for film coated tablets.
5. Disintegration test for capsules.
6. Dissolution test for immediate release tablets.
7. Dissolution test for capsules.
8. Leakage test of packaging of tablets/capsules.
9. Capsule weight variation test.

10. Determination of viscosity and specific gravity of different syrups.
11. Determination of viscosity of different suspensions.
12. Determination of the dissolution time and dissolution rate of the enteric coated diclofenac sodium tablet.
13. Determination of drug release time from enteric coated tablet.
14. In vitro dissolution study of theophylline tablet.
15. In vitro dissolution study of SRDF theophylline capsule.
16. Preparation of castor oil emulsion and determination of its pH and viscosity.
17. Determination of drug release time of different suppositories.
18. Determination of drug content in ointments.
19. Determination of drug content in creams.
20. Determination of drug content in O/W and W/O emulsions.
21. Determination of drug content in suspensions.
22. Determination of drug content in dry syrups.

N.B. The course can be designed/modified according to the course teacher.

### **B. Pharm 3<sup>rd</sup> Year: 2<sup>nd</sup> Semester**

**Course Title: Viva voce**

**Course Code: PHARM 3210**

**Credit: 1**

Every student must give a Viva voce at the end of B. Pharm Year III. Topics of the Viva voce will cover from any course of Semester-5 and Semester-6 and current affairs of Pharmaceuticals.

### **B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Pharmaceutical Analysis-II**

**Course Code: PHARM 4101**

**Credits: 3**

#### **1. Chromatographic Methods:**

- a) Introduction, principles, preparation, procedure, method of detection, classification, and applications of chromatography.
- b) Gel filtration chromatography.
- c) Thin layer chromatography.
- d) Affinity chromatography.
- e) Ion exchange chromatography.

#### **2. Spectroscopic techniques:**

- a) **Visible and Ultraviolet Spectrophotometry:** Introduction, electromagnetic radiation, units, electromagnetic spectra and absorption of radiation, Lambert's and Beer's law, deviations from Lambert-Beer law, instrumentation, colorimetry, chromophores and auxochromes, analysis of mixtures,

absorption and intensity shifts, applications of ultraviolet and visible spectroscopy in quantitative analysis of drugs.

**b) Fluorometry:** Introduction, principle, fluorescence and chemical structure, instrumentation, factors influencing intensity of fluorescence, comparison of fluorometry and uv-visible spectrophotometry, applications of fluorometry in pharmaceutical analysis.

**c) Atomic Absorption Spectroscopy:** Theory, instrumentation and application in quantitative analysis.

**3. Polarography and Amperometric Titration:** Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.

**Recommended Books:**

1. Gurdeep R. Chatwal et al. : Instrumental Methods of Chemical Analysis
2. A.H. Beckett, et al : Practical Pharmaceutical Chemistry Vol. I & II
3. K. A. Connors : A Textbook of Pharmaceutical Analysis
4. L.G. Chatten : Pharmaceutical Chemistry Vol. I & II
5. Douglas A Skoog : Principles of Instrumental Analysis
6. B.K. Sharma : Instrumental Methods of Chemical Analysis

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Medicinal Chemistry-II**  
**Course Code: PHARM 4102**  
**Credits: 3**

**1. Drug Design and Discovery:**

**a) Drug Design:** Definition, purposes and factors governing of drug design, interpretation of SAR of small molecules (sulfa drugs), design of pharmaceutical dosage forms.

**b) Drug Discovery:** Discovery of new drugs without leads, lead discovery strategies, requirements for identification of lead compounds.

**c) Drug Development:** Objectives, pharmacophore, patterns and SAR of drug development from natural sources, modification synthetic analogues, bioisosterism, homologation.

**d) Drug Design for Pharmacokinetics Problems:** Metabolic blockers, prodrugs, sentry drugs, 'search and destroy' drugs, Self-destruct drugs, drug distribution and survival of drugs.

**3. Drugs Metabolism:** Pathways of drugs metabolism, metabolism of various groups of drugs, factors affecting drugs metabolism, methods of studying drug metabolism, new aspect of drug metabolism, metabolic products of common drugs.

**4. Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs:**

**a) Antimicrobial agents:** Semisynthetic penicillins, cephalosporins and quinolone derivatives.

**b) Antidiabetic drugs:** Sulfonyl ureas, biguanides.

**c) Local anaesthetics:** Benzocaine, procaine.

**d) Non-steroidal oestrogens:** Stilbesterol, hexesterol, dienesterol.

**Recommended Books:**

1. Wilson and Gisvold : Textbook of Organic, Medicinal and Pharmaceutical Chemistry
2. Ashutosh Kar : Medicinal Chemistry
3. Graham L. Patrick : Cooper and Gunn's Dispensing for Pharmaceutical Students
4. Alfred Burger : Medicinal Chemistry Vol. I & II

5. E. J. Ariens : Drug Designs Vol. I, II & III  
6. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II  
7. W.O. Foye : Principles of Medicinal Chemistry.  
\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Drug and Disease Management-I**  
**Course Code: PHARM 4103**  
**Credits: 3**

- 1. The patient:** Signs, symptoms, clinical laboratory tests, lifestyle advice.
- 2. Treatment:** Adverse Drug Reactions and interactions, Clinical pharmacokinetics and Therapeutic drug monitoring.
- 3. GIT Disease:** Dyspepsia and peptic ulcer disease, lower gastrointestinal problems, the liver patient.
- 4. Drug Interactions:** Six pharmacokinetic mechanisms by which interactions may occur, giving a clinical example of each; three pharmacodynamic mechanisms by which interactions may occur, giving a clinical example of each two examples of a drug-food interaction; two examples of a drug alcohol interaction, one example of a drug-tobacco interaction.
- 5. Drug Delivery and Different Routes for Drug Administration:** The drug formulations commonly given by that route, the key biopharmaceutical and therapeutic considerations integral to the route of administration, a clinical condition or situation in which these may be the preferred route; oral, sublingual, buccal, parenteral; including intravenous, intraarticular, intradermal, intramuscular, subcutaneous, topical, transdermal, inhalation, intraocular, intranasal.

**Recommended Books:**

1. Helms et al : Textbook of Therapeutics Drug & Disease Management
2. Randall and Neil : Disease Management

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Clinical Pharmacy**  
**Course Code: PHARM 4104**  
**Credits: 3**

- 1. Introduction and Basic Concepts:** Clinical pharmacy and therapeutics, history, its scope and definitions.
- 2. Laboratory data and clinical manifestations:** Problems occurring with the use of drugs: self-medication, compliance Issues, drug use by the elderly, impacting the problems of drug use: medication errors, the epidemic of prescribed drug abuse.
- 3. Guidance for Special Clinical Practices:** Neonates, children, elderly, terminal care, liver disease, renal impairment, pregnancy and lactating mothers.
- 4. Pharmacotherapy Principles for Geriatric Patients:** Socio demographics, health status, age-related changes, drug-related problems, geriatric assessment, drug therapy monitoring, documentation, patient education, ambulatory geriatric clinic, long-term care, patient care and monitoring.

**5. Pharmacotherapy Principles for Pediatrics Patients:** Fundamentals of pediatric patients, effects of pharmacokinetic and pharmacodynamic differences on drug therapy, common pediatric illnesses, specific considerations in drug therapy- routes of administration and drug formulations, common errors in pediatric drug therapy, CAM and OTC medication use, medication administration to pediatric patients and caregiver education, accidental ingestion in pediatric patients, patient care and monitoring.

**6. Palliative Care:** Definition, goals, clinical presentation and diagnosis of different diseases, palliative care considerations for diseases, outcome evaluation, patient care and monitoring.

**Recommended Books:**

1. E. T. Herfindal, D.R. Gourley & L.L. Hart : Clinical Pharmacy and Therapeutics
2. Marie a. Chisholm-Burns : Pharmacotherapy Principles & Practice
3. Herfindal & Gourley : Textbook of Therapeutics-Drug and Disease Management
4. R Walker and Clive Edwards : Clinical Pharmacy and Therapeutics
5. Shargel Leon, Alan H., Paul F., and Larry N. : Comprehensive Pharmacy Review

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Biopharmaceutics-III**  
**Course Code: PHARM 4105**  
**Credits: 3**

**1. Dosage Adjustment in Renal and Hepatic Disease:**

a) Pharmacokinetic considerations, general approaches for dose adjustment in renal diseases, 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.

c) Effect of hepatic disease on pharmacokinetics, dose adjustment for hepatic patients

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

**3. Relationship between pharmacokinetic and pharmacologic responses:** Pharmacodynamics and pharmacokinetics, relation of dose to pharmacologic effect, relation between dose and duration of action, rate of drug absorption and pharmacodynamic response, drug distribution and pharmacologic response, pharmacodynamic models etc.

**4. Pharmacokinetics of Drug Interaction:** Mechanism of drug interactions, Interactions affecting absorption & distribution of drugs, Interactions affecting metabolism & excretion of drugs.

**5. Drug Product Selection on the Basis of Bioavailability Testing.**

**Recommended Books:**

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

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Hospital and Community Pharmacy**  
**Course Code: PHARM 4106**  
**Credits: 3**

**1. Introduction to Hospital Pharmacy:** 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 Control:** (i) Purchasing and Inventory Control: Purchasing agent, purchasing procedure, control on purchase, storage, perishable inventory, physical inventory, perpetual inventory. (ii) 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.

**4. 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.

**5. Manufacturing–Bulk and Sterile:** Control and budget, manufacturing facility and capacity, operating costs, quality control.

**6. Community Pharmacy:** Concept of community health care, health needs of the community, different level of health care, elements of primary health care, principles of primary health care: equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies.

**7. Rational Use of Drugs:** Background of rational use of drugs, definition, factors underlying irrational use of drugs: patients, prescribers, drug supply system; drug regulation and drug promotion, impact of irrational use of drugs with examples, disease-specific indicators, drug use patterns in developing countries, changing drug use patterns, factors effecting drug use, strategies to improve prescribing, experiences with interventions to change drug use in developing countries, strengths and weaknesses of different interventions to change drug use patterns, international network for rational use of drugs.

**Recommended Books:**

1. William E. Hasan : Hospital Pharmacy

2. M.C. Allwood : Textbook of Hospital Pharmacy
3. Parthasarathi et al : A Textbook of Clinical Pharmacy Practice
4. Stone et al : Pharmacy Practice
5. Abood : Pharmacy Practice and the Law
6. Durgib et al : Introduction to Pharmacy Practice

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Pharmaceutical Analysis-II- Lab**  
**Course Code: PHARM 4107**  
**Credit: 2**

1. Estimation of ampicillin by UV spectrophotometric method
2. Estimation of active drug in domperidone tablet by UV spectrophotometric method.
3. Determination of protein concentration in tissue preparation by UV-Vis spectrometry
4. Estimation of ferrous fumarate from iron capsule
5. Determination of ampicillin by iodometric titration.
6. Determination of potency of atenolol in the tablet by volumetric and conductometric method.
7. Determination of captopril potency in the tablet by volumetric and conductometric method
8. Compare the titration curves using conductometric method when (a) 0.01 N solution of HCl (b) 0.01N solution of oxalic acid (c) 0.01N solution of acetic acid and (d) 0.01 N solution of acetyl salicylic acid are conductometrically determined with a standard solution of sodium hydroxide.
9. Potentiometric determination of the concentrations of an iodide and a chloride sample in a mixture.
10. Determination of protein level in enzymatic drug.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 4<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Medicinal Chemistry-II Lab**  
**Course Code: PHARM 4108**  
**Credit: 2**

**Laboratory synthesis and physical, chemical and spectral characterization of the following Compounds:**

1. Esomeprazole.
2. Furosemide.
3. Ketorolac Tromethamine.
4. Cefixime.
5. Ibuprofen.
6. Naproxen.
7. Ciprofloxacin.
8. Amoxicillin.
9. Diazepam.
10. Levodopa.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutics-III**  
**Course Code: PHARM 4201**  
**Credits: 3**

**1. Capsules:**

**a) Hard Gelatin Capsules:** Definition and classification, advantages and limitations of capsule dosage form, gelatin and its manufacture, manufacture of hard capsule shells, properties of capsules, formulation of capsules, capsule filling machines, tooling and accessories, problems in capsule manufacturing, quality control methods of capsules, packaging of capsules.

**b) Soft Gelatin Capsules:** Definitions and classifications, advantages and limitations, properties, formulation, manufacturing, quality control and packaging of soft capsules, problems and remedy of soft capsule manufacturing.

**2. Microencapsulation Technology:** Purpose, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process.

**3. Sustained Release Drug Delivery Systems:** Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form.

**4. Parenteral Products:** Definition and classification of parenteral products, formulation considerations-

**a)** Pre-operational factors, water for injection, pyrogenicity, non-aqueous vehicles, isotonicity and methods of its adjustment.

**b)** Formulation techniques, containers and closures and their selection.

**c)** Prefilling treatments, washing of containers and closures, preparation of solutions and suspensions, filling and closing of ampules, vials, infusion fluids, lyophilization and preparation of sterile products, equipment for the manufacture of sterile products.

**d)** Methods of maintaining sterility.

**e)** Evaluation of parenteral products by instrumental and biological methods, LAL test and pyrogen.

**5. 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.

**6. Aerosol Science and Technology:** Definition and classification of aerosols, 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.

**Recommended Books:**

1. E. A. Rawlins : Bentley's Textbook of Pharmaceutics
2. L. Lachman, H.A. Liebernan : The Theory and Practice of Industrial Pharmacy
3. S. J. Carter : Cooper and Gunn's Dispensing for Pharmaceutical Students
4. M. E. Aulton : Pharmaceutics, the Science of Dosage Form Design

5. H. C. Ansel and N Popovich : Pharmaceutical Dosage Forms and Drug Delivery Systems
6. Randy Hendrickson et. al. : Remington, The Science and Practice of Pharmacy

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmacology-III**  
**Course Code: PHARM 4202**  
**Credits: 3**

**1. Cardiovascular Drugs:** Introduction, classification, mechanism of action of:

- a) Antihypertensive drugs
- b) Antiarrhythmic drugs
- c) Diuretics
- d) Drugs used in heart failure
- e) Drugs used in angina and myocardial infarction

**2. Antidiabetic Agents:** Introduction to diabetes, classification, causes, complications and treatment of diabetes, hypoglycemia, causes and treatment, relationship between stroke and diabetes, causes of stroke, different types of antihyperglycemic agents with mechanisms, uses, toxicity; Insulin resistance, management of diabetes, glucagon mechanism, uses.

**3. Antibacterial Agents:** Introduction, classification, mode of action and brief study of the following class of drugs

- a) Drugs affecting folate synthesis
- b)  $\beta$ -lactam antibiotics
- c) Drugs affecting protein synthesis
- d) Drugs affecting Topoisomerase-I enzyme- fluoroquinolones.
- f) Antitubercular agents
- g) Antileprotic drugs

**Recommended Books:**

1. Goodman Gilman and P. Taylor : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II
2. H. P. Rang, M. M. Dale : Pharmacology
3. K. D. Tripathi : Essentials of Medical Pharmacology
4. R. A. Harvey, P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology
5. Andres Goth : Medical Pharmacology
6. B. G. Katzung : Basic and Clinical Pharmacology
7. R. S. Satoskar and Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II

\* Other Books will be indicated by respective teachers.

## **B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**

**Course Title: Cosmetology**

**Course Code: PHARM 4203**

**Credits: 3**

**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. Raw Materials Used in Cosmetic Preparations:** Commonly used surface-active agents, humectants, antiseptics, preservatives, antioxidants, cream bases, perfumes, colors.

**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 Care Products:** Introduction, classification of skin creams, cold creams, cleansing creams, night and massage creams, moisturizing, vanishing and foundation creams, pigmented foundation creams, sun screen products, acne products, lipsticks.

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

**6. Dental Products:** Introduction, dentrifices, formulation and manufacturing of toothpastes and tooth powders, mouth wash, oral rinses.

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

Shampooing: A study of the techniques and methods used in shampooing and the removal of chemical products, including conditioning, re-conditioning, and rinse applications. Treatment of the Hair & Scalp: Recognition of hair and scalp disease, and those conditions which require medical treatments as well as those that can be treated by the cosmetologist. Methods of treatments and scientific brushing. Methods used in the art of tinting and bleaching hair.

### **Recommended Books:**

1. M. S. Balsam and E. Sagarin : Cosmetics, Science and Technology Vol. I & II.
2. Pulok K. Mukherjee : Quality control of herbal drugs.
3. A. Barel, Marc Payne et al. : **Handbook of Cosmetic Science & Technology.**
4. Elsner and Howard I. Maibach : **Cosmeceuticals and Active Cosmetics.**
5. S. N. Sahu : Preparation and distribution of Drugs and Cosmetics.

\*Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutical Analysis-III**  
**Course Code: PHARM 4204**  
**Credits: 3**

**1. Chromatographic Methods:**

a) **High Performance Liquid Chromatography:** Introduction and theoretical considerations, instrumentation, characteristics of stationary and mobile phases, reversed phase high performance liquid chromatography, latest development -UPLC & UFLC, applications.

b) **Gas Chromatography:** Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.

**2. Spectroscopic techniques:**

a) **Infrared (IR) Spectroscopy:** IR absorption process, methods of vibration and bending, bond properties and absorption trends, IR spectrophotometer, approaching the analysis of a IR spectrum, use of IR spectrum.

b) **Nuclear Magnetic Resonance Spectroscopy:** <sup>1</sup>HNMR spectroscopy: introduction and theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling; two dimensional NMR spectroscopy, nuclear over hauser effect, 2D correlated (COSY) and 2D nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC.

c) **<sup>13</sup>CNMR Spectroscopy:** Introduction, principle, chemical shift, spin-spin coupling, applications.

d) **Mass Spectrometry:** Introduction, theory, the mass spectrum, recognition of molecular ion, isotopic peaks, ionization techniques- electron impact, chemical ionization, fast atom bombardment etc.; fragmentation pattern; aliphatic and aromatic hydrocarbons, alcohols, ethers, aldehydes, ketones, acids, esters, amides etc.; analyzing techniques-magnetic sector, quadrupole; determination of molecular formula, applications of mass spectrometry.

**3. X-ray Crystallography:** Generation and properties of X-ray, diffraction of X-ray by crystals, , Bragg's equation, X-ray diffraction methods, powder diffraction patterns, methods of measurement, analysis, indexing of X-ray reflections and determination of space groups, Fourier and Patterson syntheses and application of X-ray diffraction.

**Recommended Books:**

1. Gurdeep R. Chatwal et al. : Instrumental Methods of Chemical Analysis
2. A.H. Beckett, et al : Practical Pharmaceutical Chemistry Vol. I & II
3. K. A. Connors : A Textbook of Pharmaceutical Analysis
4. L.G. Chatten : Pharmaceutical Chemistry Vol. I & II
5. Douglas A Skoog : Principles of Instrumental Analysis
6. B.K. Sharma : Instrumental Methods of Chemical Analysis

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Medicinal Chemistry-III**  
**Course Code: PHARM 4205**  
**Credits: 3**

**1. Combinatorial Chemistry and Rapid Parallel Syntheses:**

a) Introduction, various drug discovery processes, design, diversity, expression, methods & techniques, and applications of combinatorial syntheses on drug discovery.

b) Solid phase syntheses: introduction, various linkers, solid phase peptide synthesis (SPPS): principle, mechanism and application; heterocyclic synthesis.

c) Liquid phase combinatorial synthesis, dendrimer: supported combinatorial chemistry.

**2. Introduction of Computational Molecular Modeling of Drug Design:** Quantitative structure activity relationships (QSAR): physicochemical properties (hydrophobicity, electronic effects, steric factors, solvent accessible surface area etc), application of QSAR (Hansch equation, Hammett relationships) on biological systems.

**3. Chemistry, Mode of Action, SAR and Synthesis of the Following Groups of Drugs:**

a) Psychotropic drugs and antidepressants: TCA compounds, MAOIs, phenothiazine derivatives.

b) Antineoplastic drugs: alkylating agents, antimetabolites, plant products.

c) General anaesthetics: propofol, etomidate, isoflurane, benzodiazepines and barbiturates.

d) Antimalarial agents: Chloroquine, pamaquine, trimethoprim.

**4. Vitamins:** Synthesis, clinical aspects of vitamins and their effects on free radicals.

**5. Signal Transduction and its role in drug design.**

**Recommended Books:**

1. Wilson and Gisvold : Textbook of Organic, Medicinal and Pharmaceutical Chemistry
2. Ashutosh Kar : Medicinal Chemistry
3. Graham L. Patrick : Cooper and Gunn's Dispensing for Pharmaceutical Students
4. Alfred Burger : Medicinal Chemistry Vol. I & II
5. E. J. Ariens : Drug Designs Vol. I, II & III
6. O.P. Agarwal : Chemistry of Organic Natural Products Vol. I & II
7. W.O. Foye : Principles of Medicinal Chemistry.

\* Other Books will be indicated by respective teachers.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutics-III- Lab**  
**Course Code: PHARM 4206**  
**Credit: 1**

1. Preparation of paraffin ointment B.P. (50 gm).
2. Formulation and preparation of paracetamol suspension (50 ml).
3. Formulation and preparation of chlorpheniramine maleate solution (100 ml).
4. Formulation and preparation of paracetamol tablet.
5. Formulation and preparation of cotrimoxazole suspension.
6. Formulation and preparation of iron syrup (100 ml).

7. Formulation and preparation of Whitfield's ointment.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmacology-III- Lab**  
**Course Code: PHARM 4207**  
**Credit: 1**

1. Estimation of aspirin in blood after oral administration by UV spectrophotometric method.
2. Estimation of aspirin in blood after oral administration by colorimetric method.
3. Estimation of paracetamol in blood after oral administration by UV/Visible spectrophotometric method.
4. Determination of paracetamol in blood by colorimetric method.
5. Estimation of indometacin in human blood by spectrophotometric method.
6. Toxicity test of the drugs like phenobarbitone, nikethamide, some antineoplastic drugs, pilocarpine, etc.
7. Biological assay of digitalis, histamine and insulin.
8. Microbiological assay of antibiotics and vitamins.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Cosmetology- Lab**  
**Course Code: PHARM 4208**  
**Credit: 2**

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.
9. Formulation and preparation of bath oil
10. Formulation and preparation of face cream
11. Formulation and preparation of hair conditioner
12. Formulation and preparation of sun protection cream
13. Formulation and preparation of foundation makeup

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Hospital Pharmacy Training**  
**Course Code: PHARM 4209**  
**Credits: 3**

Students must go through rigorous hospital pharmacy training for 600 hours. Hospital authority will arrange their training schedule; will give training about how to manage patients in different disease conditions, prevention of diseases, safe use of drugs etc. After completion of training, students will submit the reports to the department. Examination committee will evaluate the reports and other subjects of the training.

Evaluation of the course will be in two steps such as:

**A. Report Examination: 80%**

According to the instruction of the department each student will conduct their training in a hospital. After completion of the training, they will submit 4 copies of reports (3 reports for the exam committee and 1 copy for the department). In addition, they will submit 1 copy of training certificate given by the company. The chairman and the members of the examination committee will evaluate those reports.

**B. Oral Assessment (Internship Defence): 20%**

The chairman and the members of the examination committee will evaluate the oral Assessment (Internship Defence). In the absence of any member, the other members of the exam committee can conduct all the examination as per the examination rules of the university.

**B. Pharm 4<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Viva voce**  
**Course Code: PHARM 4210**  
**Credit: 1**

Every student must attend in a Viva voce at the end of B. Pharm Year IV. Topics of the Viva voce will cover from any course of Semester-7 and Semester-8 (4<sup>th</sup> year 1<sup>st</sup> and 2<sup>nd</sup> semester) and current affairs of Pharmaceuticals.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Quality Control and Analytical Method Validation**  
**Course Code: PHARM 5101**  
**Credits: 3**

**1. Quality Control Overview:** Introduction, general information & significance of quantitative and qualitative analyses in quality control, sampling techniques, pharmacopoeial tests and specifications, standardization of pharmaceuticals and formulated products, quality control systems for drugs and pharmaceuticals, causes of poor quality, importance of pharmaceutical analysis in the quality control of

drugs, sources of quality variation, control of quality variation.terminology used in the validation of analytical procedures, regulatory basis for process validation.

**2. Validation of Analytical and biological Methods:** Strategy and parameters for the validation of methods, verification of standard methods, validation of non-routine methods, analytical validation within the pharmaceutical environment, validation of standard operating procedures (SOP), linearity, accuracy, precision, limit of detection, limit of quantification, heat sensitivity and system suitability.

**3. Potency Method Validation:** Validation practices, strategies and validation parameters, potency method revalidation, common problems and solutions. Validation of HPLC analysis: background information, method validation experiments, common problems and solutions.

**4. Performance Verification:**

**a) Performance Verification of HPLC:** Introduction, performance verification practices, operation tips for HPLC performance verification.

**b) Performance Verification of UV-Vis and IR spectrophotometers:** Introduction, performance attributes practical tips in UV-Vis and IR spectroscopic performance verification.

**5. Bioanalytical Method Validation:** Definition of bioanalytical method validation, regulatory guidance on bioanalytical method validation, current validation practices, common problems and solutions.

**6. Quality Control of Herbal Drugs:** detection of adulterants including the presence of API, safety & toxicity profile, development of standardization parameters, extraction, pharmacological screening, quality assurance and stability study of herbal drugs.

**Recommended Books:**

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

\* Other Books will be indicated by respective teachers.

## **B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Food, Nutraceuticals and Agrovet**

**Course Code: PHARM 5102**

**Credits: 3**

**1. Functional Foods:** effect of soy proteins and soy isoflavones in human health, role of dietary fibers in disease prevention, sources and role of phytochemicals, milk, dairy products, health effects of some beans, vegetables, spices, fish oils, and sea foods, general idea about role of probiotics and prebiotics as nutraceuticals, effects of trans and omega 3,6,9 fatty acids on health and diseases.

**2. Nutritional Requirements:** Balanced diet, factors affecting BMR and energy requirements for different activities, nutritional requirements for different types of physical activities and sports, nutritional requirements of vulnerable sections such as infants, pregnant and lactating women, elderly and the dietary management, malnutrition: Occurrence, manifestation, prevention and therapeutic measures.

**3. Briefly Study of Various Alternative Medicine:**

Ayurveda, Unani, Herbal Therapy, Homeopathy, Acupuncture, Acupressure:

**4. Animal Nutrition Principles:** Definition of veterinary science with brief history, contribution of veterinary medicine to human welfare, animals nutrition; nutritional importance of carbohydrates, lipids, proteins, vitamins, minerals and water; scientific feeding of livestock; feed additives; silage making, diet formulation for newborn, growing, pregnant, lactating and sick animals.

5. **Various Animal Disease and Their Treatment:** Clinical examination, etiology, clinical symptoms, diagnosis, prevention and control of diseases of digestive system; musculo-skeletal system; liver; skin; milk fever, diseases caused by deficiency of vitamin-a etc. causes, classification, drainage of wound, etc.

**Recommended Books:**

1. Costas G. Biliaderis et al. : Functional Food Carbohydrates.
2. Fereidoon Shahidi : Nutraceutical and Specialty Lipids and their Co-Products.
3. Vasant Lad, B.A.M.&S., M.A.Sc : Textbook of Ayurveda: Fundamental Principles
4. Vasant Lad : The Science of Self Healing
5. C.M. Kahn and Scott Line : The Merck Veterinary Manual.
6. D. M. McCurnin and Joanna M : Bassert. Clinical Textbook for Veterinary Technicians.

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Drug and Disease Management-II**  
**Course Code: PHARM 5103**  
**Credits: 3**

**1. Osteoporosis:** Etiology and pathology of osteoporosis; risk factors for the development of osteoporosis; lifestyle advice for prevention and treatment of osteoporosis; hormone replacement (HOURT) regimens; risks and benefits of HOURT; advantages and disadvantages of selective oestrogen receptor modulators (SERMS) and bisphosphonates.

**2. Rheumatoid Arthritis and Osteoarthritis:** The drug and non-drug measures used to manage osteoarthritis and the modern therapeutic approach used in the treatment of rheumatoid arthritis, pharmaceutical care in bone and joint disease-how pharmacists can contribute to the prevention of falls and care of patients with osteoporosis, arthritis or taking long term corticosteroids.

**3. Endocrine Disorders:** Diabetes- etiology and pathogenesis of type 1 and type 2 diabetes; aims of diabetes management; dietary and lifestyle advice for diabetes, the pharmacists' role in the prevention and identification of undiagnosed diabetes; core elements education programmes; prevention and management of hypoglycaemia; advice that should be given during intercurrent illness; the pharmacists role in risk modification to prevent long-term complications. **Thyroid disorders:** Hyperthyroidism and Hypothyroidism- clinical features, diagnosis, goals of treatment, management, pharmacological basis of management, treatment, monitoring, drug interactions, counseling.

**4. Management and treatment of different cardiovascular:** hypertension, hyperlipidemia, ischaemic heart disease, heart failure.

**5. Respiratory Disease:** clinical features, diagnosis, goals of treatment, management, pharmacological basis of management, treatment, monitoring, drug interactions, counseling of asthma and COPD.

**6. Sexually Transmitted Infections:** Signs and symptoms of, and causative organisms and treatment options for gonococcal and non-gonococcal urethritis, candidiasis, bacterial vaginosis, trichomoniasis, genital herpes, syphilis, genital warts, cervical infections.

**Recommended Books:**

1. Helms et al : Textbook of Therapeutics Drug & Disease Management
2. Randall and Neil : Disease Management

\* Other Books will be indicated by respective teachers.

## **B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Clinical Research Methodology and Clinical Pharmacokinetics**

**Course Code: PHARM 5104**

**Credits: 3**

1. **Basic terminology used in clinical research:** Guidelines for undertaking clinical trials, Types of clinical trials, single blinding, double blinding, open access, randomized trials and their examples, interventional study, ethics committee and its members, cross over design, etc...and Institution Ethics Committee / Independent Ethics Committee Data Management in clinical Research. data to be submitted for clinical trial structure, content & format for clinical study report, approval for clinical trials, responsibility of sponsor, investigator & ethical committee.
2. **Basic Concept and General Discussion on Clinical Research:** Pre clinical, toxicity studies, evolution of drugs and regulatory framework, drugs discovery and development, clinical data management, ICH GCP introduction.
3. **Pre clinical toxicology:** General principles, Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity, Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements.
4. **Clinical trials:** New drug discovery process- purpose, main steps involved in new drug discovery process, timelines of each steps, advantages and purposes of each steps, ethics in clinical research, unethical trials, thalidomide tragedy, Phase-I, II, III, IV trials.
  - i. Introduction and designing
  - ii. Various phases of clinical trials
  - iii. Post marketing surveillance
  - iv. Methods -principles of sampling
  - v. Inclusion and exclusion criteria
  - vi. Informed consent process in brief
  - vii. Termination of trial
  - viii. Safety monitoring in clinical trials
5. **Kinetics following Extravascular Administration:** Describe concentration: time profile of first order absorption, define absorption rate constant and bioavailability, estimation of pharmacokinetic parameters following extravascular administration.

### **Recommended Books:**

1. Goodman Gilman, etal. : Goodman and Gilman's The Pharmacological Basis of Therapeutics Vol. – I & II.
2. R. S. Satoskar and Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II.
3. K. D. Tripathi : Essentials of Medical Pharmacology.
4. Andres Goth : Medical Pharmacology.
5. R. A. Harvey and P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology.
6. B. G. Katzung : Basic and Clinical Pharmacology.

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Biostatistics and Bioinformatics**  
**Course Code: PHARM 5105**  
**Credits: 3**

**A. Biostatistics**

- 1. Introduction to statistics:** Definition, scope and application of statistics in Pharmacy, collection and presentation of data, arithmetic mean, geometric mean, harmonic mean, weighted mean, median and mode, equation of straight lines; determination of slope and intercept, graphs and diagrams
- 2. Measures of dispersion:** Range, mean deviation, standard deviation, variation, coefficient of variation, standard deviation; moments, skewness, and kurtosis.
- 3. Basic concept of probability and probability distribution:** The normal, binominal and Poisson distribution, derivation, means and variances.
- 4. The correlation and regression analysis of measurement:** General concept of correlation and regression, calculation of correlation coefficient; basic idea of regression, calculation of regression coefficient.
- 5. Tests of Hypothesis:** Basic concepts of tests of significance, tests of means and variances based on normal, t,  $\chi^2$  and F distributions, tests of independence in a contingency table.

**B. Bioinformatics**

- 1. Introduction and Bioinformatics Databases:** Definition of bioinformatics, basic concepts of protein and nucleic acid, sequence structure and function, relation of bioinformatics with molecular biology, different types of nucleotide sequence databases, protein sequence databases, sequence motif databases, protein structure databases.
- 2. Sequence Alignment and Database Searching:** Single sequence alignment, pairwise alignment, database searching including BLAST, multiple sequence alignments, local alignment and global alignment (algorithm and example), pairwise alignment (BLAST and FASTA algorithm) and multiple sequence alignment (Clustal W algorithm).

**Recommended Books:**

1. J. E. Freund and G. A. Simon : A Modern elementary statistics
2. J. S. Miltion & J. O. Tsokos : Statistical Methods in the Biological and Health Sciences
3. B. K. Mahajan : Methods in Biostatistics for Medical Students and Research Workers
4. Gupta, S.C. and Kapoor, V.K.(1.001) : Fundamentals of Applied Statistics
5. Yule, G. U. and Kendall, M. G. : An Introduction to the Theory of Statistics
6. Larson : Bioinformatics and Drug Discovery
7. Chouristine Orengo : Bioinformatics: Genes, Proteins and Computers

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Pharmaceutics-IV**

**Course Code: PHARM 5106**

**Credits: 3**

- 1. Special Drug Delivery System:** Transdermal therapy, ophthalmic preparation, nano drugs, liposoms, blood products and plasma substitutes etc.
- 2. Pharmaceutical Operations:** Design, development and process validation methods for pharmaceutical operations.
- 3. Performance Evaluation Methods:** In vitro dissolution studies, methods and interpretation of dissolution data.
- 4. Plant Design:** Design of a pharmaceutical manufacturing plant in keeping with cGMP guidelines.
- 5. 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 rooms, routine monitoring tests, the operation of clean and aseptic rooms, key factors in clean room operations.
- 6. Packaging of Pharmaceutical Products:** Packaging components, types, specification & methods of evaluation, stability aspects of packaging, packaging equipment, factors influencing choice containers, uqal & other factors influencing choice of containers, uqal & other official requirements for containers, package testing.
- 7. Pharmaceutical waste management and ETP treatment**

**Recommended Books:**

1. D. M. Collett and M. Aulton : Pharmaceutical practice Churchill Livingstone.
2. Lachman et. al. : Pharmaceutical Dosage Forms: Tablets
3. Lachman, Lieberman : The Theory And Practice Of Industrial Pharmacy.
4. Lieberman et. al. : Pharmaceutical Dosage Forms: Disperse Systems.
5. Lieberman et. al. : Pharmaceutical Dosage Forms: Parenteral Medication.
6. M. E. Aulton Pharmaceutics : The science of dosage form design Livingstone
7. Willig and Storker : GMP for Pharmaceuticals.

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**

**Course Title: Quality Control and Analytical Method Validation- Lab**

**Course Code: PHARM 5108**

**Credit: 2**

1. Calibration of UV spectrophotometer through absorbance and wavelength checks.
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 ratio 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 plastics used for packing pharmaceutical products.
8. Test of packaging materials, cartons, aluminum foils, films used for blister packing, ampoules, vials, etc.
9. Control of starting materials, intermediate, bulk and finished products.
10. Analytical method validation of drugs.
11. Qualification of systems and equipments.
12. Non-sterile process validation.
13. Sterility testing.
14. Antimicrobial efficacy testing (AET).
15. Microbial limits testing.
16. Endotoxin testing.
17. Validation of laboratory computer systems.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 5<sup>th</sup> Year: 1<sup>st</sup> Semester**  
**Course Title: Clinical Pharmacy and Pharmacokinetics- Lab**  
**Course Code: PHARM 5109**  
**Credit: 2**

The practical course will be conducted as designed by the course teacher.

2. Determination of Liver marker: SGPT, SGOT, TP, etc.
3. Determination of Kidney marker: creatine, creatinine etc.
4. Determination of Lung function: FVC, PEF<sub>1</sub>, FEV<sub>1</sub>, FVC/FEV<sub>1</sub> etc.
5. Determination of Analgesic activity of drugs or extracts: Tail immersion test, Writhing test, Hotplate test.
6. Determination of anti inflammatory effect of drugs or extracts by using Carragenan induced paw edema test, formalin induced licking test.
7. Determination of antidiarrhoeal activity of drugs or extracts by using Castor oil and magnesium sulphate induced diarrhea in animals.
8. Detection of electrolytes in animal stools by using flame photometer.
9. Evaluation of anxiolytic and CNS depressant effect of drugs.
10. Evaluation of CNS stimulant effect of drugs.
11. Determination of elimination rate of a drug by using animal model.
12. Determination of hemolytic and anti hemolytic effect of drugs.
13. Clinical evaluation of any drug or agent in human or animal model.

N.B. The course can be designed/modified according to the course teacher.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Toxicology and Drug Interactions**  
**Course Code: PHARM 5201**  
**Credits: 3**

- 1. Basic Concept and General Discussion on Clinical Research:** Pre clinical, toxicity studies, evolution of drugs and regulatory framework, drugs discovery and development, clinical data management, ICH GCP introduction.
- 2. Acute Poisoning:** The different types of poisoning, the general principles of management of acute poisoning and the management of poisoning with aspirin, paracetamol and drugs of misuse.
- 3. Animal and Clinical Toxicology:**(i)Animal Toxicology: Animal pharmacology, human pharmacology (phase I), therapeutic exploratory trail (phase II), therapeutic confirmatory trails (phase III), post marketing trails (phase IV), studies in special population, special studies: bioavailability /bioequivalence, pharmacovigilance. (ii)Clinical Toxicology: Role of poison centers, adverse reactions and poisoning incidences, analysis of poisoning situations, poison information sources, assessment of poison exposure.
- 4. 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. Metal poisoning
- 5. Determination of:** LD<sub>50</sub>, LC<sub>50</sub>, acute toxicity, bioassays, neurotoxicity utilizing forced locomotor activity test, determination of convulsant dose for CNS stimulants, experiments on neuromuscular relaxation, animal experiments with abuse drugs.
- 6. Case History Study of Patients with:** Constipation and diarrhea, hypertension, pain, nausea and vomiting diabetes mellitus, drug in pregnancy and lactation, eczema and psoriasis.

**Recommended books:**

1. M. N. Ghosh : Fundamentals of Experimental Pharmacology

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmacy Practice**  
**Course Code: PHARM 5202**  
**Credits: 3**

1. **Introduction:** definitions, scopes of pharmacy practices. Current global trends of pharmacy practices.
2. **Rules & regulations of pharmacy practices:** child registrant packaging, controlled substances, legend drugs, pharmacy licensure, processing of prescriptions, physical facilities and environment control, prescription monitoring, model rules of pharmaceutical care.
3. **Special Pharmacy Practices:** Good Pharmacy Practice (GPP) -definition, requirements of GPP, national standards for GPP. Total Pharmacy Care. Medication Therapy Management. Collaborative Pharmacy Practices. Seamless Pharmacy Care, Drug and Poison Information.

4. **Patient Communication:** process of patient communication, patient empowerment, optimization of environment for communication, barriers in communication, appropriate techniques of patient counseling, medication interview. Professional communications
5. **Patient behavior determinants:** significance and types of patient behaviors, models of health behavior, factors influencing health behavior, effects of quality of providers interaction on patient behavior. Health Collaboration Model.
6. **Applied ethics in pharmacy practice:** definitions, review of Pharmacists' Code of Ethics of Bangladesh and some other foreign countries. Ethical values and dilemmas. Resolving ethical dilemmas.
7. **Preparation and administration of medications:** Total Parenteral Nutrients, Cytotoxic drugs, Vinca alkaloids, Potassium Chloride injections, Anticoagulants, Blood products.

**Recommended Books:**

1. William E. Hasan : Hospital Pharmacy
2. M.C. Allwood : Textbook of Hospital Pharmacy
3. Parthasarathi et al : A Textbook of Clinical Pharmacy Practice
4. Stone et al : Pharmacy Practice
5. Abood : Pharmacy Practice and the Law
6. Durgib et al : Introduction to Pharmacy Practice

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Drug and Disease Management- III**  
**Course Code: PHARM 5203**  
**Credits: 3**

**1. Skin Disease and Management:** Management (food and drug) and adequate patient education of skin disease in human such as scabies, eczema, psoriasis, purities, acne, etc.

**2. Management of Different Cancer:** Application of medications, food, radiation, physical activity for management of cancers such as prostate cancer, pancreatic cancer, breast cancer, blood cancer, colon cancer, lung cancer, thyroid cancer.

**3. Management of Renal Disease:** Treatment & management of tuberous sclerosis, nephropathy, chronic kidney disease; blood pressure control, management of protein to control renal disease.

**4. Management of HIV/AIDS:** Management of AIDS patients by using different classes of drugs such as nucleoside reverse transcriptase inhibitors (NRTI) and nucleotide reverse transcriptase inhibitors (NtRTI), non-nucleoside reverse transcriptase inhibitors (NNRTI), additional diet tips, awareness of AIDS to the people.

**5. Management of Central Nervous System Disorders:** Treatment & management of migraine, epilepsy, anxiety disorders, insomnia, schizophrenia, drug interactions, over the counter medicines and dietary supplements, counseling.

**6. Hepatic Disease and Their Management:** Sign and symptoms, common causes, complications, diagnosis, and management of alcoholic liver disease, acute liver failure, drug and toxin induced

hepatotoxicity, liver cirrhosis, management of patients with chronic liver diseases, treatment of viral hepatitis (B and C) etc.

**Recommended books:**

1. Sleisenger and Fordtran's Gastrointestinal and Liver Disease : Feldman
2. Clinical pharmacy and therapeutics : Roger Walker
3. The Chemotherapy & Radiation Therapy Survival Guide : Nancee Hirano
4. Treatment of Skin disease : Mark G. Lebwohl
5. Randall and Neil : Disease Management

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**

**Course Title: Pharmacology-IV**

**Course Code: PHARM 5204**

**Credits: 3**

**1. Chemotherapeutic Drugs:**

- a) **Immunosuppressive Agents:** Cytotoxic drugs, glucocorticoids, antibodies, specific T-cell inhibitors.
- b) **Antineoplastic Drugs:** Alkylating agents, antimetabolites, antibiotics, microtubule inhibitors
- c) **Antiviral Drugs:** Anti-herpes virus, ant retro virus, anti-influenza virus, nonselective antiviral drugs, drugs used in acquired immune deficiency syndrome (AIDS)
- d) **Antifungal Drugs**

**2. Drugs affecting Central Nervous System:**

- a) **Psychotropic and Antidepressant Drugs:** Classification, mode of action, pharmacological actions, indications, toxicities and contraindications of different drug classes.
- b) **Anxiolytic and Hypnotic Drugs**
- c) **CNS Stimulants**
- d) **Antiepileptic Drugs:** types of seizures, classification, mode of action, pharmacological actions, indications, adverse reactions of different drugs

**3. Hormones:** Biochemistry and mode of action of hormones, Hormones as drugs. Anti-fertility drugs: Oral contraceptives, mechanical barriers, implants, foams, etc.

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

**Recommended Books:**

1. Wilson and Gisvolds : Textbook of Organic, Medicinal and Pharmaceutical Chemistry
2. A. Goldstein and L. Aronow : Principles of Drug Action, The Basis of Pharmacology
3. R. A. Harvey and P. C. Champe : Lipponcott's Illustrated Reviews Pharmacology
4. R. S. Satoskar and Bhandarkar : Pharmacology and Pharmacotherapeutics Vol. I & II
5. Craig and Stitzel : Modern Pharmacology
6. Laurence and Bennett : Clinical Pharmacology
7. Davidson : Principles and Practice of Medicine
8. S. Vincent, Devita, Rosenberg : Cancer, Principles and Practices of Oncology
9. Pratti : Anticancer Drugs

\* Other Books will be indicated by respective teachers.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Pharmaceutical Industry Training**  
**Course Code: PHARM 5205**  
**Credits: 4**

Every student must complete their training in a pharmaceutical industry during the 5<sup>th</sup> year 2<sup>nd</sup> semester. After completion of the training, students must submit their reports. Examination committee will evaluate the reports and other subjects of the trainings.

Evaluation of the course will be in two steps such as:

**A. Report Examination: 80%**

According to the instruction of the department each student will conduct their training in a pharmaceutical company. After completion of the training, they will submit 4 copies of reports (3 reports for the exam committee and 1 copy for the department). In addition, they will submit 1 copy of training certificate given by the company. The chairman and the members of the examination committee will evaluate those reports.

**B. Oral Assesment (Internship Defence): 20%**

The chairman and the members of the examination committee will evaluate the oral Assesment (Internship Defence). In the absence of any member, the other members of the exam committee can conduct all the examination as per the examination rules of the university.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**  
**Course Title: Research Project**  
**Course Code: PHARM 5206**  
**Credits: 4**

Research projects will be selected through discussion between the assign supervisors and students. The supervisors will be responsible for the research activities and report submission.

Evaluation of the course will be in two steps such as:

**A. Report Examination: 80%**

According to the decision of the academic committee each teacher will supervise students. At the end of the semester, each student will submit 4 copies of project reports (3 reports for the exam committee and 1 copy for the department). The examination committee will send the reports to the external and internal examiner for evaluation (80%). The external and internal examiner will be selected by the exam committee itself. If there is a 20% marks difference between the external and internal examiner, the reports will be evaluated by the third examiner.

**B. Oral Assesment /Project Defence (20%) :**

Every student must attend the Oral Assessment / Project Defence ceremony arranged by the exam committee. All the members of the exam committee will evaluate the Oral Assessment / Project Defence. In the absence of any member, the other members of the exam committee can conduct all the examination as per the examination rules of the university.

**B. Pharm 5<sup>th</sup> Year: 2<sup>nd</sup> Semester**

**Course Title: Viva voce**

**Course Code: PHARM 5207**

**Credits: 2**

Every student must give a Viva voce at the end of B. Pharm Year V. Topics of the viva voce will cover from any course of entire B. Pharm program and current affairs of pharmaceuticals.