

# **Syllabus of B. Pharm. (Hon's)**

## **Autumn-2019**



**Department of Pharmacy**  
**Faculty of Science and Engineering**  
**International Islamic University Chittagong**  
**Chittagong, Bangladesh**

# **International Islamic University Chittagong**

## **Department of Pharmacy**



### **Syllabus for 4 Years Bachelor of Pharmacy (Honors)**

**Semester: Spring, Session: 2019**

Submitted for approval in the 41<sup>th</sup> meeting of upcoming Academic Council will be held on 26<sup>th</sup> January, 2019

As per recommendations made in the 129<sup>th</sup> meeting of Faculty of Science and Engineering Committee held on 8<sup>th</sup> January, 2019

As per recommendations made in the 17<sup>th</sup> meeting of Committee of Courses of the Department of Pharmacy held on 7<sup>th</sup> January, 2019

As per recommendations made in the 186<sup>th</sup> meeting of Academic Committee of the Department of Pharmacy held on 12<sup>th</sup> December, 2018

Sl.	Contents	Page No.
1.	The Mission, Vision, Objectives and Motto of IIUC .....	5
1.1	Introduction .....	5
1.2	The Mission of the University .....	5
1.3	The Vision of the University .....	5
1.4	The Objective of the University .....	5
1.5	The Motto of the University is to “Combine Quality with Morality” .....	5
2.	Teaching Methods and Policy .....	5
2.1	Methods .....	5
2.2	Policy .....	5
2.3	Morality Development Program .....	6
2.4	Co-Curricular and Extra-curricular activities .....	6
2.5	Student Advisor .....	6
3.	The Vision, Mission and Objectives of the Faculty of Science and Engineering.....	6
3.1	The Vision of the Faculty of Science and Engineering .....	6
3.2	The Mission of the Faculty of Science and Engineering .....	6
3.3	The Objectives of the Faculty of Science and Engineering .....	6
4.	Vision, Mission of the Department of Pharmacy and Program Educational Objectives and Program Outcome.....	7
4.1	The Vision of the Department of Pharmacy .....	7
4.2	The Mission of the Department of Pharmacy .....	7
4.3	Program Educational Objectives.....	7
4.4	Program Outcomes (PO) .....	7
4.5	Mapping between Program Educational Objectives (PEOs) and Program Outcomes (POs).....	8
5.	Duration of Program .....	8
6.	Course Identification Plan .....	8
7.	Programs of Study .....	9
7.1	Marks distribution for projects/thesis is as follows .....	9
7.2	Basis for awarding marks for attendance is generally as follows .....	9
8.	Admission Requirements .....	9
8.1	The general academic qualifications for admission to B. Pharm (Hon’s)..	9
8.2	Other Requirements .....	10
9.	The Credit Hour System at IIUC .....	10

10. Grading System .....	10
11. Grade Point Average (GPA) .....	10
12. Earned Credit .....	11
13. Course Requirements for Undergraduate Pharmacy students .....	11
13.1 Introduction .....	11
13.2 B. Pharm (Hon's) curriculum as per PCB standard syllabus guidelines	11
13.3 In-Plant Training .....	11
13.4 Semester wise break up of B. Pharm (Hon's) courses .....	12

### First Semester

PHARM-1101 Introduction to Pharmacy.....	15
PHARM-1103 Inorganic Pharmacy .....	16
PHARM-1104 Inorganic Pharmacy Lab .....	17
PHARM-1105 Physical Pharmacy-I.....	18
PHARM-1106 Physical Pharmacy-I Lab.....	19
PHARM-1107 Cell Biology and Anatomy .....	19
COMP-1101 Computer Fundamentals .....	20
UREL-1106 Advanced English.....	21
UREM-1101 Text of Ethics and Morality.....	24

### Second Semester

PHARM-1201 Organic Pharmacy .....	27
PHARM-1202 Organic Pharmacy Lab .....	28
PHARM-1203 Pharmacognosy and Phytochemistry-I.....	29
PHARM-1204 Pharmacognosy and Phytochemistry-I Lab .....	30
PHARM-1205 Physical Pharmacy-II .....	30
PHARM-1206 Physical Pharmacy-II Lab .....	31
PHARM-1207 Human Physiology-I.....	32
PHARM-1208 Human Physiology-I Lab.....	33
PHARM-1213 Oral Assessment-I .....	34
MATH-1201 Fundamentals of Mathematics .....	34
URED-1201 Basic Principles of Islam ('Aqidah+ 'Ibadah).....	35

### Third Semester

PHARM-2301 Basic Pharmaceutics.....	37
PHARM-2303 Pharmacognosy and Phytochemistry-II .....	38
PHARM-2304 Pharmacognosy and Phytochemistry-II Lab .....	39
PHARM-2305 Biochemistry and Molecular Biology-I.....	40

PHARM-2307	Human Physiology-II .....	41
PHARM-2308	Human Physiology-II Lab.....	42
PHARM-2309	Pharmaceutical Microbiology and Immunology-I.....	42
PHARM-2310	Pharmaceutical Microbiology and Immunology Lab.....	43
STAT-2301	Biostatistics .....	44
STAT-2302	Biostatistics Lab.....	45
URED-2302	Sciences of <i>Qur'an</i> and <i>Hadith</i> .....	45
URED-2305	Comparative Religion.....	47

#### Fourth Semester

PHARM-2401	Pharmaceutical Technology-I .....	49
PHARM-2402	Pharmaceutical Technology-I Lab .....	50
PHARM-2403	Biochemistry and Molecular Biology-II .....	51
PHARM-2404	Biochemistry and Molecular Biology Lab .....	52
PHARM-2405	Pharmacology-I .....	52
PHARM-2406	Pharmacology-I Lab .....	54
PHARM-2407	Pharmaceutical Microbiology and Immunology-II.....	54
PHARM-2409	Pharmaceutical Analysis-I .....	55
PHARM-2410	Pharmaceutical Analysis-I Lab.....	56
PHARM-2413	Oral Assessment-II.....	57
URBL-2401	Functional Bengali Language.....	57

#### Fifth Semester

PHARM-3501	Pharmaceutical Technology-II .....	59
PHARM-3502	Pharmaceutical Technology-II Lab .....	60
PHARM-3503	Biopharmaceutics and Pharmacokinetics-I .....	61
PHARM-3504	Biopharmaceutics and Pharmacokinetics-I Lab .....	62
PHARM-3505	Pharmacology-II .....	63
PHARM-3506	Pharmacology-II Lab.....	64
PHARM-3507	Medicinal Chemistry-I .....	65
PHARM-3508	Medicinal Chemistry-I Lab .....	66
PHARM-3509	Pharmaceutical Biotechnology .....	66
URED-3503	Introduction to Political Thoughts and Social Behavior .....	67

#### Sixth Semester

PHARM-3601	Pharmaceutical Dispensing .....	70
PHARM-3603	Biopharmaceutics and Pharmacokinetics-II .....	71
PHARM-3604	Biopharmaceutics and Pharmacokinetics-II Lab .....	72

PHARM-3605	Hospital and Community Pharmacy .....	72
PHARM-3607	Medicinal Chemistry-II.....	73
PHARM-3608	Medicinal Chemistry-II Lab .....	74
PHARM-3609	Pharmaceutical Analysis-II .....	75
PHARM-3610	Pharmaceutical Analysis-II Lab .....	76
PHARM-3611	Pharmaceutical Engineering-I .....	76
PHARM-3613	Oral Assessment-III .....	78
URED-3604	Life and Teachings of the Prophet Muhammad (SAAS) .....	78
<b>Seventh Semester</b>		
PHARM-4701	Pharmaceutical Technology-III .....	80
PHARM-4702	Pharmaceutical Technology-III Lab .....	81
PHARM-4703	Pharmaceutical Quality Assurance .....	82
PHARM-4705	Pharmacology-III .....	83
PHARM-4706	Pharmacology-III Lab .....	84
PHARM-4707	Pharmaceutical Regulatory Affairs .....	84
PHARM-4709	Pharmaceutical Analysis-III .....	85
PHARM-4711	Pharmaceutical Engineering-II .....	86
URIH-4701	A Survey of Islamic History and Culture .....	88
<b>Eighth Semester</b>		
PHARM-4801	Food Technology, Nutraceuticals and Herbal Medicines.....	90
PHARM-4803	Pharmaceutical Quality Control and Validation .....	91
PHARM-4805	Cosmetology .....	92
PHARM-4806	Cosmetology Lab .....	93
PHARM-4807	Medicinal Chemistry-III .....	93
PHARM-4809	Clinical Pathology and Toxicology .....	94
PHARM-4811	Pharmaceutical Marketing and Management .....	96
PHARM-4813	Oral Assessment-IV .....	97
PHARM-4814	Project .....	97
URBS-4802	Bangladesh Studies and History of Independence .....	97
14	Mapping of Course Outcomes (CO) to Program Outcomes (PO) at Course Level and Program Level	100

## **1. The Mission, Vision, Objectives and Motto of IIUC:**

**1.1 Introduction:** International Islamic University Chittagong (IIUC) is one of the top graded government approved private universities in Bangladesh. Having fulfilled the requirements as laid down in the Private University Act of 1992, and after obtaining the necessary clearance from University Grants Commission (UGC), and the permission of Government of Bangladesh (GOB) through the Ministry of Education, **International Islamic University Chittagong (IIUC)** started functioning on **February 11, 1995**. The credit for the idea of establishing this University goes to International Islamic University Chittagong Trust (IIUCT). IIUC framed its own Statutes, Ordinances and Regulations governing the manifold activities of IIUC - academic, administrative, financial, student welfare, discipline etc. as per the **Private University Act, 1992, 1998 and revised Act, 2010**. Most statutory bodies formed under the provisions of the Act have since then been functioning.

**1.2 The Mission of the University** is to produce through the pursuit of education properly trained up manpower to contribute to socio-economic development and moral upliftment of the society and to cultivate in our students expertise as well as ethical sensitivity, intelligence and an ability to think independently beyond their areas of study, so that they can sustain justice in all walks of life.

**1.3 The Vision of the University** is to offer nationally competitive and internationally recognized opportunities for learning to make this University as the Centre of Excellence in different areas of scholarship, like Shari'ah and Islamic Studies, Business Studies, Social Science, Science and Engineering, Arts and Humanities, Law, and such other faculties that will be introduced in future. Its door is open to the admission seekers from all over the world, regardless of race, region and religion. This university cherishes the dream of becoming one of the highest seat of learning and creator of knowledge in the South East Asia.

### **1.4 The Objective of the University:**

(a) To create a new generation of competent youths, who will be equipped with academic excellence, professional expertise and adorned with moral height.

(b) To follow a policy of continued Modernization of Knowledge and academic curricula in different disciplines of education so that its students can imbibe the true spirit of religious value as an effective guiding principle in their profession and daily life.

### **1.5 The Motto of the University is to “Combine Quality with Morality”.**

## **2. Teaching Methods and Policy:**

**2.1 Methods:** *Outcome-based education (OBE) and Bi- Semester system of Continuous Quality Improvement (CQI) through self-examination and external review.* In this process students are evaluated throughout a course of study rather than exclusively by examination at the end. It is multidimensional based on student's (a) attendance in the Classes; (b) performance in Assignments and Class Tests, (c) Scores in the Mid-Term and the Final Examination (d) Lab. Reports, (e) Thesis/ Project/ internship, (f) Presentations (g) Viva-voce, (f) Industry visits (g) Co-Curricular and Extra-curricular activities.

**2.2 Policy:** The University is committed to the life-long success of students in its undergraduate and master's programs through high-quality instruction and learning experiences. IIUC has Integrated Education Policy, where a student achieves holistic learning through awareness of his surroundings and other relevant knowledge bases. IIUC emphasizes the diffusion of scientific, technical and professional knowledge on the one hand, and

building up of character in youth by making religion and ethics an integral part of education on the other. In this regard, there are some courses for the students of all Faculties at IIUC, which are not a part of the main curriculum of the Departments, but those are named as **University Requirement Courses (URC)**.

**2.3 Morality Development Program: IIUC** incorporates studies on the values of mutual respect and peaceful co-existence in the courses under the “**Morality Development Program (MDP)**” which includes all students of the university irrespective of caste, creed or religion.

**2.4 Co-Curricular and Extra-curricular activities: IIUC** supports student participation in a broad array of *Co-Curricular and Extra-curricular activities* as an integral component of its commitment to student life and success. These programs mainly includes leadership training, cultural, environmental, recreational and social activities, debating and public speaking programs, intellectual discussions, games and sports, excursion and study tours home and abroad to complement academic pursuits. By these programs students earn capacity to express out themselves properly, maintain personality and learn to respect people of other faiths through mutual understandings among various regions, religions, beliefs and cultures. All *Co and Extra-curricular* activities are run by the clubs named after the Departments such as Computer club, Business club etc under the close supervision and monitoring of Students Affairs Division (STAD).

**2.5 Student Advisor:** IIUC provides academic counseling, career and student welfare counseling by the Student Advisor of the respective section of students of each semester.

### **3. The Vision, Mission and Objectives of the Faculty of Science and Engineering:**

#### **3.1 The Vision of the Faculty of Science and Engineering:**

The vision of the Faculty of Science and Engineering is to be a dynamic centre of innovation and creativity dedicated to teaching, learning, professionalism, research, entrepreneurship, and partnership with local and global communities. The aims of the Faculty are to provide international standard quality programs of undergraduate and graduate education; to be a research active unit advancing the knowledge of science and engineering; and to serve the community and industry as an agent of technological, and educational innovation and advancement.

#### **3.2 The Mission of the Faculty of Science and Engineering:**

The mission of the Faculty of Science and Engineering is to foster excellence in teaching, research, and learning within a systems approach to science and engineering education. Our goal is to produce engineering graduates with both a strong base of technical knowledge and the complementary skills needed to be successful professional engineers in the modern world.

#### **3.3 The Objectives of the Faculty of Science and Engineering:**

The Faculty plans to achieve this vision and mission through the pursuit of the following specific objectives:

- a) To provide high quality degree programs of international standards at undergraduate and graduate level.
- b) To build programs to meet evolving student, industry, and community needs.
- c) To advance research and scholarship by promotion of excellence in education and professionalism.
- d) To build the physical infrastructure and human resource capacity to ensure our students are gaining the skills, experience and ethical values needed to work as professional engineers.

- e) To foster collaboration with academic institutions and professional bodies in the region and beyond so as to extend our impact to the country, region and whole world.

#### **4. Vision, Mission of the Department of Pharmacy and Program Educational Objectives and Program Outcomes:**

##### **4.1 Vision of the Department of Pharmacy:**

- a) To prepare tomorrow's pharmacist who will professionally as well as ethically and socially responsible.
- b) To provide an academic environment to think critically, lead, and work consistently across professions and fields.
- c) To meet and improve society's health, wellness and health care.

##### **4.2 Mission of the Department of Pharmacy:**

To develop pharmacists through innovative pharmaceutical education, practice and research to improve the healthcare of local and global communities.

##### **4.3 Program Educational Objectives (PEO):**

- i. To prepare graduates to be qualified pharmacists capable of working in pharmaceutical industry, community, hospital, clinic and other pharmacy sectors.
- ii. To produce pharmacist having skills and ability equivalent to International standards of pharmacy practice.
- iii. To impart scientific knowledge with regard to professional code of ethics for the identification, formulations, preparation, standardization, quality control as well as safe and effective management of drugs.
- iv. To conduct scientific and clinical researches.

##### **4.4 Program Outcomes (PO):**

After completion of the B. Pharm (Hons) program, students should be able to:

- i. Acquire knowledge and scientific skills for appropriate development of pharmaceutical dosage forms.
- ii. Figure out the fundamental applications of modern manufacturing and analytical equipment used in the pharmaceutical industry and research purposes.
- iii. Evaluate the quality of different drugs and dosage forms in accordance with the standard monographs.
- iv. Understand the molecular, cellular and physiological mechanisms underlying normal function of the cell/organ as well as pathophysiological changes to cures underlying diseases.
- v. Insight into microbial pathogenesis, host-parasite interactions, and immune system to defense and prevent disease with respect to microbes.
- vi. Monitor and evaluate the effectiveness of drug therapy through pharmacokinetic and pharmacodynamic considerations.
- vii. Use of appropriate knowledge for the design and development of biologically and clinically active drugs.
- viii. Demonstrate the ability to use critical analysis and problem solving skills to provide high quality, evidence-based pharmacy services and patient care.
- ix. Conceive the importance of research for the advancement of pharmaceutical care.
- x. Exhibit exemplary legal, ethical and professional conducts complying with all national and international pharmacy laws and regulations.
- xi. Identify and describe the medicinal plants and functional foods that confer health benefits and contain bio-active compounds.

#### 4.5 Mapping between Program Educational Objectives (PEOs) and Program Outcomes (POs):

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PEO1	✓	✓	✓			✓		✓			
PEO2	✓		✓					✓		✓	
PEO3	✓	✓	✓		✓			✓		✓	
PEO4	✓		✓	✓	✓	✓	✓		✓		✓

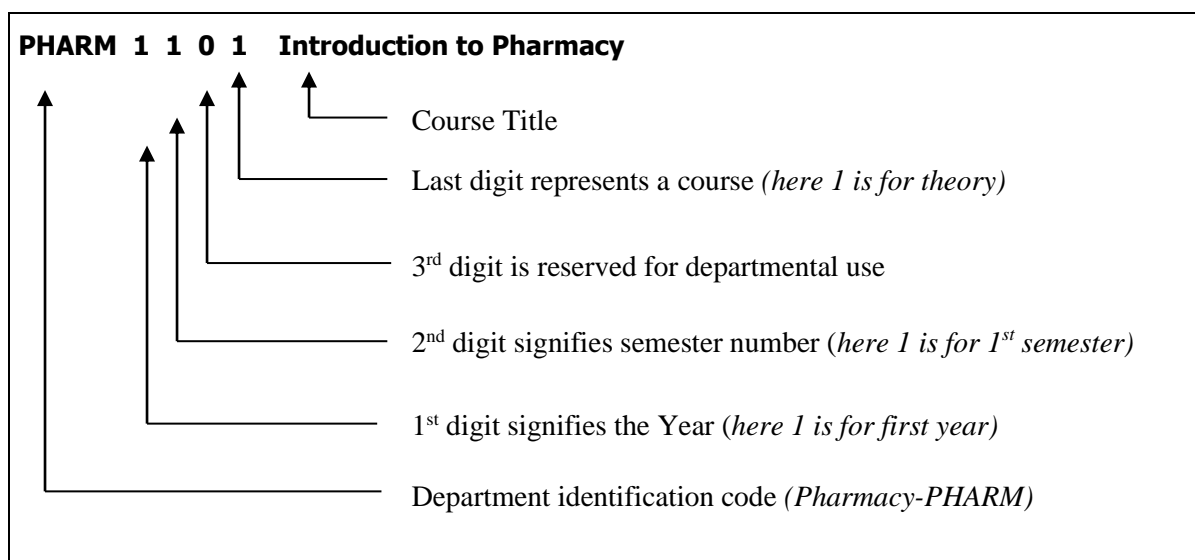
#### 5. Duration of Program:

To complete the Bachelor of Pharmacy (Hons.) program at the International Islamic University Chittagong, normally takes four academic years (i.e. 8 Semesters). Each academic year is divided into 2 Semesters (Spring Semester: March-August and Autumn Semester: September-February), each having duration of 15 weeks. The duration of theory classes shall be of 60 minutes. One unit of theory (1T) is normally 3 credit hours and 3 contact hours. One unit of Lab. (1L) is 1 credit hour and 2 contact hours. There shall be assignments, class tests, mid-term, final exam, thesis/ project/ internship, presentations, viva-voce, industry visits, co-curricular and extra-curricular activities.

The Mid-term Examination will be held after conducting 6 weeks classes. After Mid-term examination and conducting of 9 weeks classes, Final examination will be held at the end of each semester. In order to graduate, total 165 credit hours to be undertaken and completed by a student during 8 semesters. A student may be allowed to complete their graduation studies in the University within maximum of six academic years (i.e.12 semesters). No student shall ordinarily be admitted after the class starts.

#### 6. Course Identification Plan:

Following code plan has been adapted for course identification: First digit stands for Year, the Second digit stands for Semester, the Third digit stands for Group and the Fourth digit stands for the course number (odd number has been assigned to theory course and the even number has been assigned to lab course).



## 7. Programs of Study:

The B. Pharm (Hons) program consists of 83 courses carrying 165 Credit Hours. Each theory course carries 100 marks of which 10 marks for class tests/assignments/oral tests (at least one assignment and one class test before Mid-term and also after Mid-term), 10 marks for attendance, 30 marks for Mid-term examination and 50 marks for the Final examination. Lab course also carries 100 marks of which 50 marks allotted for running assessment and 50 marks for practical exam, viva, quiz etc at the end of semester final examination. Oral Assessment carries 100 marks will be conducted after final examination of each academic year. After successful completion of 165 credits hours students will be awarded B. Pharm (Hons) Degree.

### 7.1 Marks distribution for projects/thesis is as follows: (as per UGC suggestion)

- a) Project/Thesis evaluation by Supervisor - 40%
- b) Project/Thesis evaluation by Examiner - 30%
- 3) Project/thesis presentation and defense - 30%

---

Total = 100%

### 7.2 Basis for awarding marks for attendance is generally as follows:

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

## 8. Admission Requirements:

Admission at IIUC is purely on the basis of merit. Furthermore, admission to the available programs depends on the type and level of the program that a candidate wishes to pursue.

### 8.1 The general academic qualifications for admission to B. Pharm (Hons):

- a) Students seeking admission to pursue the course for the degree of Bachelor of Pharmacy (B. Pharm) should have passed the S.S.C. and. H.S.C. (or 'O' level and. 'A' level) examinations in science group or equivalent degrees with at least GPA 3.0 in a scale of 5.0 without any additional subject.
- b) Candidate must have a minimum aggregate GPA 6.50 in SSC/ "O" level or equivalent and HSC/ "A" level or equivalent examinations in a total scale of 10.0. In all levels the students must have to secure B grade (credit point 3.00) in chemistry and biology separately and a minimum GPA 2.0 in mathematics.
- c) Foreign students must have passed 12 education years and got same grades in equivalent examinations from foreign recognized institutions will be eligible to get admission in any Private university as per rules and regulation of education and foreign ministry.

- d) The student must to pass HSC/ "A" level or recognized equivalents with the following science subjects: Physics, Chemistry, Biology and Mathematics to qualify for admission.
- e) Candidate must pass HSC/ "A" level or recognized equivalent examination in current year or one previous year.
- f) However candidates having no Mathematics at the HSC/ "A" level or recognized equivalents may be admitted, but they need to take an extra 3 (three) credits course on Mathematics other than offered syllabus relevant to B. Pharm. Curriculum.

English is the primary language used as the medium of instruction in the University.

## 8.2 Other Requirements:

Admission to IIUC is always through a competitive Admission Test (written and oral). All applicants are required to undergo the process to qualify for admission into different programs of study. However, sound health, good character and financial capability to carry on the entire program are also taken into consideration.

## 9. The Credit Hour System at IIUC:

To bring the academic system to international standard, IIUC follows Open Credit Hour System (OCHS) based on a quantified curriculum, whereby a certain number of credit hours are assigned to each course. Students are required to complete successfully the total number of credit hours stipulated in the program requirements in order to graduate. The number of credit hours assigned to each course denotes the academic load that a student carries while registering for that course. Therefore, a course that carries three credit hours normally has three contact hours per week. There are some courses that are normally not a part of the main curriculum of the department, but of the University Requirement Courses (URC) such as religions and language/general education courses etc.

## 10. Grading System:

The Grading System for assessing the performance of the students shall be as follows:

Numerical Grade Marks%	Letter Grade (LG)	Grade Point (GP/unit)	Remarks/Status
80-100	A+ (A plus)	4.00	Excellent
75 to less than 80	A (A regular)	3.75	Very good
70 to less than 75	A- (A minus)	3.50	
65 to less than 70	B+ (B plus)	3.25	Good
60 to less than 65	B (B regular)	3.00	
55 to less than 60	B- (B minus)	2.75	Satisfactory
50 to less than 55	C+ (C plus)	2.50	
45 to less than 50	C (C regular)	2.25	Pass
40 to less than 45	D (D regular)	2.00	
Less than 40	F	0.00	Fail

*The performance of a student will be evaluated in terms of semester grade point average (GPA) and cumulative grade point average (CGPA) which is the grade average for all semesters. To have graduation degree a student must obtain CGPA at least 2.5.*

## 11. Grade Point Average (GPA):

The Grade Point Average (GPA) is computed by dividing the total grade points earned by the number of credit hours attempted in a given semester. The Cumulative Grade Point Average

(CGPA) is computed by dividing the total grade points earned by the total number of credit hours attempted at the University up to a particular semester.

### 12. Earned Credit:

The courses in which a student has obtained minimum 'D' in 'Theoretical courses Laboratory courses and General Viva-Voce' or higher grade will be counted as credits earned by the student. Any course in which a student has obtained 'F' grade will not be counted towards his/her earned credit. 'F' grade will not be counted for GPA calculation but will stay permanently on the Grade sheet and transcripts.

### 13. Course Requirements for Undergraduate Pharmacy students:

#### 13.1 Introduction:

The undergraduate students of the Department of Pharmacy have to follow the course schedule given below. The letter prefix in any course number indicates the discipline of the course viz. PHARM for Pharmacy core courses and others for General Education/ University Requirement Courses like MATH for Mathematics, STAT for Statistics and COMP for Computer course etc.

#### 13.2 B. Pharm (Hons) curriculum as per Pharmacy Council of Bangladesh (PCB) standard syllabus guidelines:

To prepare students to meet their career objectives, B. Pharm (Hons) curriculum is composed (as per PCB and UGC standard syllabus guidelines) by the following categories of courses as shown below:

#### Summary of Courses:

Categories of Courses	Types	No. of Course	Credit Hours	Credit Hours and Percentage (%)	Remarks
Core Courses	Theory	41	113	137 (83.03%)	
	Lab	24	24		
General Education: Language, Inter disciplinary and University Requirement Courses (URC)	Theory	12	20	21 (12.73%)	
	Lab	1	1		
Project and Viva-Voce	Project	1	3	7 (4.24%)	
	Viva	4	4		
<b>Total Courses: 83 [Theory = 53; Lab = 25 Viva = 04; Project = 01]</b>			<b>165</b>	<b>165 (100%)</b>	

#### 13.3 In-Plant Training

An internship training and report submission is required before conferring the Bachelor of Pharmacy (Honors) degree. This internship training is mandatory for all the students after they have completed at least 140 credits. The internship will be arranged in pharmaceutical industries located in Bangladesh.

### 13.4 Semester wise break up of B. Pharm (Hons) courses:

#### First Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-1101	Introduction to Pharmacy	2	2	None
2.	PHARM-1103	Inorganic Pharmacy	3	3	None
3.	PHARM-1104	Inorganic Pharmacy Lab	1	2	None
4.	PHARM-1105	Physical Pharmacy-I	3	3	None
5.	PHARM-1106	Physical Pharmacy-I Lab	1	2	None
6.	PHARM-1107	Cell Biology and Anatomy	2	2	None
7.	COMP-1101	Computer Fundamentals	2	2	None
8.	UREL-1106	Advanced English	2	3	None
9.	UREM-1101	Text of Ethics and Morality	1	2	None
	<b>Total</b>		<b>17</b>	<b>21</b>	

#### Second Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-1201	Organic Pharmacy	3	3	None
2.	PHARM-1202	Organic Pharmacy Lab	1	2	None
3.	PHARM-1203	Pharmacognosy and Phytochemistry-I	3	3	None
4.	PHARM-1204	Pharmacognosy and Phytochemistry-I Lab	1	2	None
5.	PHARM-1205	Physical Pharmacy-II	3	3	PHARM-1105
6.	PHARM-1206	Physical Pharmacy-II Lab	1	2	PHARM-1106
7.	PHARM-1207	Human Physiology-I	3	3	PHARM-1107
8.	PHARM-1208	Human Physiology-I Lab	1	2	None
9.	PHARM-1213	Oral Assessment-I	1	0	None
10.	MATH-1201	Fundamentals of Mathematics	3	3	None
11.	URED-1201	Basic Principles of Islam ('Aqidah+ 'Ibadah)	2	2	None
	<b>Total</b>		<b>22</b>	<b>25</b>	

#### Third Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-2301	Basic Pharmaceutics	3	3	None
2.	PHARM-2303	Pharmacognosy and Phytochemistry-II	3	3	PHARM-1203
3.	PHARM-2304	Pharmacognosy and Phytochemistry-II Lab	1	2	PHARM-1204
4.	PHARM-2305	Biochemistry and Molecular Biology-I	2	2	None
5.	PHARM-2307	Human Physiology-II	3	3	PHARM-1207
6.	PHARM-2308	Human Physiology-II Lab	1	2	PHARM-1208
7.	PHARM-2309	Pharmaceutical Microbiology and Immunology-I	3	3	None
8.	PHARM-2310	Pharmaceutical Microbiology and Immunology Lab	1	2	None
9.	STAT-2301	Biostatistics	2	2	None
10.	STAT-2302	Biostatistics Lab	1	2	None
11.	URED-2302	Sciences of Qur'an and Hadith	1	2	None
	<b>Total</b>		<b>21</b>	<b>26</b>	

*URED-2305	Comparative Religion	3	4	None
------------	----------------------	---	---	------

\*For non-Muslim students substitute to URED-1201, URED-2302.

### Fourth Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-2401	Pharmaceutical Technology-I	3	3	PHARM-2301
2.	PHARM-2402	Pharmaceutical Technology-I Lab	1	2	None
3.	PHARM-2403	Biochemistry and Molecular Biology-II	2	2	PHARM-2305
4.	PHARM-2404	Biochemistry and Molecular Biology Lab	1	2	None
5.	PHARM-2405	Pharmacology-I	3	3	None
6.	PHARM-2406	Pharmacology-I Lab	1	2	None
7.	PHARM-2407	Pharmaceutical Microbiology and Immunology-II	3	3	PHARM-2309
8.	PHARM-2409	Pharmaceutical Analysis-I	3	3	None
9.	PHARM-2410	Pharmaceutical Analysis-I Lab	1	2	None
10.	PHARM-2413	Oral Assessment-II	1	0	PHARM-1213
11.	URBL-2401	Functional Bengali Language	2	2	None
	<b>Total</b>		<b>21</b>	<b>24</b>	

### Fifth Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-3501	Pharmaceutical Technology-II	3	3	PHARM-2401
2.	PHARM-3502	Pharmaceutical Technology-II Lab	1	2	PHARM-2402
3.	PHARM-3503	Biopharmaceutics and Pharmacokinetics-I	3	3	None
4.	PHARM-3504	Biopharmaceutics and Pharmacokinetics-I Lab	1	2	None
5.	PHARM-3505	Pharmacology-II	3	3	PHARM-2405
6.	PHARM-3506	Pharmacology-II Lab	1	2	None
7.	PHARM-3507	Medicinal Chemistry-I	3	3	None
8.	PHARM-3508	Medicinal Chemistry-I Lab	1	2	None
9.	PHARM-3509	Pharmaceutical Biotechnology	3	3	None
10.	URED-3503	Introduction to Political Thoughts and Social Behavior	1	2	None
	<b>Total</b>		<b>20</b>	<b>25</b>	

### Sixth Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-3601	Pharmaceutical Dispensing	2	2	None
2.	PHARM-3603	Biopharmaceutics and Pharmacokinetics-II	3	3	PHARM-3503
3.	PHARM-3604	Biopharmaceutics and Pharmacokinetics-II Lab	1	2	PHARM-3504
4.	PHARM-3605	Hospital and Community Pharmacy	3	3	None
5.	PHARM-3607	Medicinal Chemistry-II	3	3	PHARM-3507
6.	PHARM-3608	Medicinal Chemistry-II Lab	1	2	PHARM-3508
7.	PHARM-3609	Pharmaceutical Analysis-II	3	3	PHARM-2409
8.	PHARM-3610	Pharmaceutical Analysis-II Lab	1	2	PHARM-2410
9.	PHARM-3611	Pharmaceutical Engineering-I	3	3	None
10.	PHARM-3613	Oral Assessment-III	1	0	PHARM-2413
11.	URED-3604	Life and Teachings of the Prophet Muhammad (SAAS)	1	2	None
	<b>Total</b>		<b>22</b>	<b>26</b>	

### Seventh Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-4701	Pharmaceutical Technology-III	3	3	PHARM-3501
	PHARM-4702	Pharmaceutical Technology-III Lab	1	2	PHARM-3502
2.	PHARM-4703	Pharmaceutical Quality Assurance	3	3	None
3.	PHARM-4705	Pharmacology-III	3	3	PHARM-3505
4.	PHARM-4706	Pharmacology-III Lab	1	2	PHARM-3506
5.	PHARM-4707	Pharmaceutical Regulatory Affairs	2	2	None
6.	PHARM-4709	Pharmaceutical Analysis-III	3	3	PHARM-3609
7.	PHARM-4711	Pharmaceutical Engineering-II	3	3	PHARM-3611
8.	URIH-4701	A Survey of Islamic History and Culture	1	2	None
	<b>Total</b>		<b>20</b>	<b>23</b>	

### Eighth Semester

Sl.	Course Code	Course Title	Credits	Contact Hours	Prerequisite
1.	PHARM-4801	Food Technology, Nutraceuticals and Herbal Medicines	2	2	None
2.	PHARM-4803	Pharmaceutical Quality Control and Validation	2	2	PHARM-4703
3.	PHARM-4805	Cosmetology	2	2	None
	PHARM-4806	Cosmetology Lab	1	2	None
4.	PHARM-4807	Medicinal Chemistry-III	3	3	PHARM-3607
5.	PHARM-4809	Clinical Pathology and Toxicology	3	3	None
	PHARM-4811	Pharmaceutical Marketing and Management	3	3	None
6.	PHARM-4813	Oral Assessment-IV	1	0	PHARM-3613
7.	PHARM-4814	Project	3	3	None
8.	URBS-4802	Bangladesh Studies and History of Independence	2	2	None
	<b>Total</b>		<b>22</b>	<b>22</b>	

## First Semester

<b>Course Code: PHARM-1101</b>		
<b>Course Title: Introduction to Pharmacy</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To know about the history of pharmacy, evolving scope of pharmacy practice, ethical foundations, regulation, educational and career opportunities of pharmacists.

**Course Outcomes:** Upon successful completion of the course, students will be able to:

- Understand evolution in the pharmacy practice and traditional medicines.
- Critically appraise the issues related to pharmacist's code of ethics.
- Familiar with the different pharmaceutical official books and regulatory organizations.

### Section-A (Mid-term: 30 Marks)

- 1. History and Evaluation of Pharmacy:** Pharmacy practice in Ancient ages, Middle Ages, Modern Ages; development of pharmacy in Bangladesh.
- 2. Pharmacy Education and its Specialty:** Brief introduction of the courses taught in a pharmacy program, pharmacy education in Bangladesh, pharmacy education in abroad.
- 3. 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.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 4. Definition of Drugs and Medicines:** Sources of drugs, classification of drugs on the basis of actions, target organs and uses; different types of dosage forms; Definitions: drugs, medicine, essential drugs, crude drugs, biological drugs, non-biological drugs, semi-synthetic drugs, synthetic drugs, me-too drugs, thermolabile drugs, OTC drugs, official/non-official/unofficial drugs, dangerous drugs, narcotic drugs, legend drugs, misbranded drugs, chemical name, generic name and brand name, placebo etc.
- 5. Differences 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.

#### Group-B (30 Marks)

- 6. Different Systems of Medicine:** History, principle, diagnosis and treatment of disease by Ayurvedic, Unani, Homeopathic and Herbal medicine systems; recent interests in herbal medicines.
- 7. Drug Standards:** Pharmacopoeias and formularies (USP, BP, NF, BNF, BDNF etc.), monographs of drugs, drug regulation and control.
- 8. Pharmacist's Code of Ethics:** Oath of a pharmacist, professional pharmacy organizations in Bangladesh and abroad; Local and Foreign drug regulatory bodies.

**Recommended Books:**

1. Rashid, M.A and Mazid, MA (2014) *Fundamentals of Pharmacy and Pharmacy Practice*. Ashrafia Boighar.
2. Amran, M.S. *Introduction to Pharmacy*, 2<sup>nd</sup> edition. Dhaka.
3. Tyler, V.E, Brady, L.R and Robbers, J.E (1982) *Pharmacognosy*. Lea and Febiger.
4. Evans, W.C (2002) *Trease and Evans' Pharmacognosy*. Saunders/Elsevier.
5. Wallis, T.E (2005) *Textbook of Pharmacognosy*. Churchill Livingstone/Elsevier..
6. Zafar, R and Gandhi, N (2007) *Practical Pharmacognosy*. CBS Publishers and Distributors.

<b>Course Code: PHARM-1103</b>		
<b>Course Title: Inorganic Pharmacy</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about the inorganic chemicals used in the pharmaceuticals and studying their basic laws and behaviors, alkali, alkaline earth metals and halogen, oxidation-reduction reactions, impurities, gastrointestinal agents, radio pharmacy, pharmaceutical important salts.

**Course Outcomes:** At the end of the course, students will be able to:

- Learn basic concepts of inorganic chemistry and radiopharmaceuticals.
- Understand importance of trace elements and their preparations.
- Know pharmaceutical importance and applications of inorganic compounds.
- Interpret types of radiation and their interaction, use of radioactive compounds.

### **Section-A (Mid-term: 30 Marks)**

- 1. Structure of Atoms:** Fundamental particles, origin of spectral lines and elementary treatment of theories of atomic structure, quantum numbers, Pauli's exclusion principle, Hund's rule, Aufbau principle, shapes of s, p, d, f orbitals.
- 2. Classification of Elements:** Electronic structure of atoms, modern periodic table and periodic law, variation of properties within periods and groups, usefulness and limitation of periodic table. Electronic configuration, physical and chemical properties of alkali, alkaline earth metals and halogens including their pharmaceutical applications.
- 3. The Chemical Bonds:** Electronic concept of valency, different types and formation of chemical bonds, e.g., ionic, covalent, co-ordinate covalent, metallic, hydrophobic, Vander Waal's force, hydrogen bond, etc., concept of atomic orbital, theories of covalent bonding and hybridization, biological importance of hydrogen bond.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 4. Oxidation-Reduction Reactions:** Definition, oxidation number, equivalent weight of oxidant and reductant, importance and determination of redox potential.
- 5. Coordination and Complex Compounds:** Definition, Ligands, coordination number, Werner's theory, electronic interpretation, structures of coordination compounds, Valence Bond theory and hybridization approach. Chelation: chelating agents, chelation therapy pharmaceutical applications.
- 6. Water:** Hardness of water, treatment of natural water, distilled water, demineralized water and official water, water for injection (WFI) etc.

#### **Group-B (30 Marks)**

- 7. Inorganic Pharmaceutical Agents:** Classification, preparation and applications of gastrointestinal agents (antacids, adsorbents, laxatives); dental preparations (antiplaque agents, fluorides, anticaries agents, dentifrices); topical agents (antimicrobial, astringent, protective agents).
- 8. Essential Electrolytes and Trace Elements:** Intra and extra cellular electrolytes (Na, K, Ca and Cl ions.); Electrolytes in acid base therapy; electrolytes in replacement therapy, electrolyte combination therapy. Essential trace elements and their preparations (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), pharmaceutical applications of essential trace elements.
- 9. Radioactivity and Radiopharmaceuticals:** Introduction, 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.

**Recommended Books:**

1. Block, J.H, Roche, E.B, Soine, T.O, Wilson, C.O (1975) *Inorganic Medicinal and Pharmaceutical Chemistry*. Lea and Febiger.
2. Soine, T.O, Wilson C.O (1967) *Roger's Inorganic Pharmaceutical Chemistry*, 8<sup>th</sup> ed. Lea and Febiger.
3. Haider, S.Z (2000) *Introduction to Modern Inorganic Chemistry*, 2<sup>nd</sup> ed. Friends Int'l.
4. Madan, R.D (2011) *Satya Prakash's Modern Inorganic Chemistry*, 3<sup>rd</sup> ed. S.Chand and Company.
5. Lee, J.D (1998) *Concise Modern Inorganic Chemistry*, 5<sup>th</sup> ed. Wiley-Blackwell.
6. Strohfeldt, K.A (2015) *Essentials of Inorganic Chemistry*. John Wiley and Sons.
7. Sarker, S.D, Nahar, L. (2007) *Chemistry for Pharmacy Students*. John Wiley and Sons.
8. Taylor, D.R and Williams, D.M (1995) *Trace Element Medicine and Chelation Therapy*. Royal Society of Chemistry.
9. Discher, C.A, Medwick, T, Bailey. L.C (1985) *Modern Inorganic Pharmaceutical Chemistry*, 2<sup>nd</sup> ed. Waveland.
10. Atherden, L.M (1969) *Bentley and Driver's Textbook of Pharmaceutical Chemistry*. Oxford University Press.

<b>Course Code: PHARM-1104</b>		
<b>Course Title: Inorganic Pharmacy Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To know qualitative analysis of inorganic compounds, identification of inorganic ions from pharmaceutical formulations, conversion of different water insoluble or sparingly soluble drugs into water soluble form, and preparation of inorganic drugs.

**Course Outcomes:** By the end of the course, students will be able to:

- Know methods to determine the impurities in inorganic drugs and pharmaceuticals.
- Learn qualitative and quantitative analysis of inorganic double salt and metal ions.

**Experiments:**

1. Preparatory class: Identification and mode of handling and cleaning of glassware tools and instrument etc.
2. Separation of metal ions into groups.
3. Identification of acid radicals.
4. Systematic qualitative analysis of inorganic single salts: NaCl, MgSO<sub>4</sub>, CaCl<sub>2</sub>, NaNO<sub>3</sub>, CdSO<sub>4</sub>, NaCO<sub>3</sub>, CaSO<sub>4</sub>, FeSO<sub>4</sub> etc.
5. Systematic qualitative analysis of inorganic double salt:
  - a) NaCl+MgSO<sub>4</sub>
  - b) CaCl<sub>2</sub>+NaNO<sub>3</sub>
  - c) CaSO<sub>4</sub>+MgSO<sub>4</sub>
  - d) CdCl<sub>2</sub>+Al(NO<sub>3</sub>)<sub>3</sub>
  - e) MgSO<sub>4</sub>+NaNO<sub>3</sub>
  - f) AlCl<sub>3</sub>+CuSO<sub>4</sub>
  - g) Cu(NO<sub>3</sub>)<sub>2</sub>+Cd(NO<sub>3</sub>)<sub>2</sub>
6. Quantitative estimation of Ca<sup>2+</sup>, Fe<sup>2+</sup>, Zn<sup>2+</sup>, Al<sup>3+</sup>, Mg<sup>2+</sup>, K<sup>+</sup> and Na<sup>+</sup> ions from supplied pharmaceutical formulations.
7. Preparation of inorganic drugs:
  - a) Preparation of aluminum hydroxide gel.
  - b) Preparation of magnesium hydroxide gel.
8. Determination of total hardness of water.

<b>Course Code: PHARM-1105</b>		
<b>Course Title: Physical Pharmacy-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about the physicochemical properties of solution and gas, preparation of different concentrations, interaction and compatibility of different materials as well as chemical, ionic and phase equilibrium of drug molecules at different conditions.

**Course Outcomes:** After completion of the course, students will be able to:

- State physicochemical properties of drug molecules, gas and solutions.
- Determine pH, buffer capacity, methods to increase solubility.
- Explain properties of chemical, ionic and phase equilibrium.

### **Section-A (Mid-term: 30 Marks)**

- 1. Properties of Gases:** Gas laws, ideal gas equation, Dalton's law of partial pressure, diffusion of gases, kinetic theory of gases, mean free path, deviation from ideal gas behavior, Vander Waals equation, critical constants, liquefaction of gases, determination of molecular weights, law of corresponding states and heat capacity.
- 2. Solutions:** Types and properties of solutions, units of concentration, ideal and real solutions, Henry's law, distribution of solids between two immiscible liquids, distribution law, partition coefficient and solvent extraction.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 3. Colligative Properties of Dilute Solutions:** Lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure including necessary thermodynamic derivations.
- 4. Buffer Capacity:** Preparation of buffers, types, buffers and isotonic systems, methods for adjustment of tonicity of solutions, importance of buffers in pharmaceutical and biological systems.

#### **Group-B (30 Marks)**

- 5. Chemical Equilibria:** Law of mass action, determination of equilibrium constant, heterogeneous equilibrium and homogenous equilibrium, Le Chatelier principle and Vant Hoff equation.
- 6. Ionic Equilibria:** Theories of acids and bases, classification of acids, bases and salts, strength of acids and bases, determination of strength gradient of acids and bases. pH, determination of pH of different acids and bases, salt solutions and buffers, titration curves of acids and bases and indicators.
- 7. Phase Equilibria:** Phase, components and degrees of freedom, phase rule and its thermodynamic derivation, phase diagrams of water and sulphur systems; lyophilization.

**Recommended Books:**

1. Saiko, P. J (2006) *Martin's Physical Pharmacy*, 4<sup>th</sup> ed. Lippincott Williams and Wilkins.
2. Haque, M.M, and Nawab, M.A (2009) *Principle of Physical Chemistry*. Brothers Publications.
3. Bahl, A, Bahl, B.S, Tuli G.D (2000) *Essentials of Physical Chemistry*, S.Chand and Company.
4. Glasstone, S. and Lewis, D. (1960) *Elements of Physical Chemistry*. Macmillan.
5. Atkins, P, de Paula, J, Keeler, J. (2017) *Atkins' Physical Chemistry*, 11<sup>th</sup> ed. Oxford University Press.
6. Alexeyev, V. (2005) *Quantitative Analysis*. CBS Publishers.
7. Florence, A. T, Attwood, D (2011) *Physicochemical Principles of Pharmacy*, 5<sup>th</sup> ed. Macmillan.

<b>Course Code: PHARM-1106</b>		
<b>Course Title: Physical Pharmacy-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge about preparation and physicochemical of pharmaceutical materials.

**Course Outcomes:** Upon completion of the course, students will be able to:

- Demonstrate use of physicochemical properties of different organic solvents.
- Prepare solvents with different strength useful for pharmaceutical preparations.

#### **Experiments:**

1. Apparatus used in Physical Pharmacy lab and their use.
2. Preparation of 100 ml 0.1M and 0.1N sodium hydroxide solution.
3. Preparation of 100 ml 0.1M and 0.1N oxalic acid solution.
4. Preparation of 100 ml 0.1M, 0.2M, 0.5M solution from 2M supplied NaOH solution.
5. Standardization of strong acid with weak base and weak acid with strong base.
6. Determination of molecular weight of organic salts by chemical method.
7. Determination of heats of solution of simple salts by calorimeter.
8. Determination of distribution coefficients of benzoic acid between - hexane and octane.
9. Determination of distribution coefficients of benzoic acid between - ether and water.
10. Determination of heat of neutralization of HCl with NaOH.

<b>Course Code: PHARM-1107</b>		
<b>Course Title: Cell Biology and Anatomy</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To provide basic knowledge on structure of cell, cell organelles, different types of tissues and anatomy of different organs of human body.

**Course Outcomes:** At the end of the course, students will be able to:

- Understand cell proliferation, different types of tissues, bones and their physiological importance.
- Explain anatomy and functions of different organs as well as interactions among them.
- Know hormonal secretions and their functions.

#### **Section-A (Mid-term: 30 Marks)**

##### **1. Cell and Tissue:**

- a) **Cell:** History, Structure and functions, organelles of the cells and their functions, basic concept on DNA, RNA, and cell division, proliferation and cell death.
- b) **Tissue:** Definition and classification. Epithelial tissue, connective tissue, muscle tissue, blood, bone and cartilage, nerve tissue, functions of various tissues and their minute structure.

##### **2. Gastrointestinal System:** Peritoneum, functions of peritoneum, nine regions of the abdomen.

- a) **Gastrointestinal Tract (GIT):** Abdomen:quadrant and regions, viscera, function;Peritoneum: parts, functions;Parts of GIT; esophagus, stomach, location of stomach, subdivisions of stomach, parts of small and large intestine, villi and their function, difference between large and small intestine.

**Section-B (Final Exam: 50 Marks)**  
**Group-A (20 Marks)**

- b) **Liver:** External features, parts, functions and applied anatomy; Gall bladder.  
c) **Spleen:** External features, functions, red and white pulp.  
d) **Pancreas:** External features, parts, functions, ducts and applied anatomy, and exocrine and endocrine pancreas.

**3. Cardiovascular System:** Mediastinum, divisions of mediastinum, anatomy of heart, chambers of heart, opening and valves of the heart, circulatory system.

**Group-B (30 Marks)**

**4. Urinary System:** Parts of the urinary system, differences between right and left kidney, fissures, anatomy of the kidney, size and shape of the kidney, functions of kidney, external feature of the kidney, structure of the kidney, nephron, parts of the nephron, ureter, urinary bladder, urethra, urine and its composition, applied anatomy.

**5. Respiratory System:** Anatomy of lung, cardiac dullness, bronchial tree, unit of lungs, alveoli, functions of lungs.

**6. Endocrine System:** Anatomy, location of the various endocrine glands; hormonal secretions and functions of pituitary gland, thyroid, parathyroid, suprarenal glands. Diabetes mellitus, ADH, oxytocin.

**7. Reproductive System:**

- a) **Male reproductive system:** parts of male sex organ, parts of penis, structure and layers of testes, sperm.  
b) **Female reproductive system:** parts of female sex organ, ovary, layers of uterus and parts of uterine tube, placenta and menstruation.

**Recommended Books:**

1. Standring, S. (2008) *Gray's Anatomy*, 40<sup>th</sup> ed (International student's edition). Churchill Livingstone.
2. Chaurasia, B.D, *Human Anatomy* (Volumes I, II, III), 4<sup>th</sup> ed. CBS Publishers.
3. Netter, F.H, (2014) *Atlas of Human Anatomy*, 6<sup>th</sup> ed. Saunders/Elsevier.
4. Tortora, G.J and Nielson, M.T (2012) *Principles of Human Anatomy*, 12<sup>th</sup> ed. John Wiley and Sons.
5. Reece, J.B, Urry, L.A, et.al (eds) (2014) *Campbell's Biology*, 10<sup>th</sup> ed. Pearson.
6. De Robertis, E. (1987) *Cell and Molecular Biology*, 8<sup>th</sup> ed. Lippincott Williams and Wilkins.
7. Reza, S. (2006) *Essentials of Gross Anatomy and Histology*. Essence Publications.
8. Guyton, A.C and Hall, J.E (2005) *Textbook of Medical Physiology*, 11<sup>th</sup> ed. Saunders/Elsevier.
9. Barrett, K.E, et.al (2005) *Ganong's Review of Medical Physiology*, 22<sup>th</sup> ed. Lange/McGraw-Hill.

<b>Course Code: COMP-1101</b>			
<b>Course Title: Computer Fundamentals</b>			
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 5px;"><b>Credit Hours: 02</b></td> <td style="width: 33%; padding: 5px;"><b>Contact hours per week: 02</b></td> <td style="width: 33%; padding: 5px;"><b>Total Hours: 30</b></td> </tr> </table>	<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>	

**Course Objectives:** To bridge fundamental concepts of computers with the present level of knowledge of the students and to familiarize operating systems, programming languages, peripheral devices, networking, multimedia and internet.

**Course Outcomes:** Upon successful completion of the course, students will be able to:

- Recall and infer the fundamentals of computer, its components, structure and types.
- Learn digital communication and networking system.
- Identify and apply the knowledge of internet, graphics and multimedia.
- Gain knowledge on computer applications in different sectors of pharmacy.

**Section-A (Mid-term: 30 Marks)**

**1. Introduction of Computer and its Organization:** Historical evolution of computers and classification, Computer generations, Basic organization and functional units of

computer, Input/ output/storage/arithmetic logic/control and central processing unit, Internal structure of CPU.

- 2. Number Systems, Computer Codes and Arithmetic:** Non-positional/positional number system, different number systems and their conversion, Fractional numbers, Numeric/alphanumeric data, BCD/EBCDIC/ASCII code, Binary arithmetic (Addition, subtraction, multiplication and division).

**Section-B (Final Exam: 50 Marks)**

**Group-A (20 Marks)**

- 3. Computer Memory:** Memory location and address, RAM, ROM, PROM, and EPROM, cache memory, Sequential/Direct/Random access device, Magnetic tape and disk, hard disk, floppy disk, CDROM, optical disk.
- 4. I/O Devices, Logic Gates:** Input and output devices, Printers, Keyboard, Mouse, Scanner, and other devices, Basic concepts of logic gates, truth table, OR gate, AND gate, XOR gate, NOR gate, universal gates.

**Group-B (30 Marks)**

- 5. Computer Program, Software and Language:** Program planning, algorithms, flow charts, pseudocode, Software and firmware, types of computer software, types of computer language, translator, interpreter, compiler.
- 6. Data Communication and Computer Network:** Basic elements of a communication system, Types of communications among computers, characteristics of communication channels, Computer Networks, LAN, MAN, WAN, Network topologies.
- 7. Computer applications 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.

**Recommended Books:**

1. Rahman, M.R and Hossain, M.A (2016) *Computer Fundamentals*. Systech Publications.
2. Sinha, P.K and Sinha, P (2004) *Computer Fundamentals*, 6<sup>th</sup> ed. BPB Publications.
3. Norton, P. (2017) *Introduction to Computer*, 7<sup>th</sup> ed. McGraw-Hill.
4. Subramanian, N. (1986) *Introduction to Computers: Fundamentals of Computer Science*. McGraw-Hill.
5. Rajarman, V. and Adabala, N. (2015) *Fundamentals of Computers*, 6<sup>th</sup> ed. Prentice-Hall.
6. Jain, S. *Introduction to Computer Science*. BPB Publications.

<b>Course Code: UREL-1106</b>		
<b>Course Title: Advanced English</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:**

- Helping the students to know the basics of English language
- Developing confidence about the correctness of their language
- Enabling them to write accurately and to comprehend English texts
- Enabling them to understand sentence patterns while they read.

**Course Outcomes:** By the end of this course students are expected to be able to:

- Make sentence of their own on the basis of their knowledge about grammar.
- Identify their own mistakes in their writing and speaking and correct the same.
- Write accurate sentences with full confidence of their correctness

- Develop ideas about some ethical values.

**Section-A (Mid-term: 30 Marks)**  
**Grammar-10, Reading-1 (Seen-10), Reading-2 (Unseen-10)**

**1. Basics of Grammar:**

- a) Kinds of sentences
  - i. Structures of assertive, imperative, imperative with let, interrogative (Y/N and WH question) optative and exclamatory
  - ii. Basic sentence patterns of assertive sentence
  - iii. Affirmative and negative structures
  - iv. Simple, complex and compound
- b) Parts of speech
  - i. Introducing each part of speech
  - ii. Showing use of same words as different parts of speech
  - iii. Changing words into different parts of speech and formation of sentences with them.
- c) Pre modifier and post modifier
  - i. Introducing adjectives, participles, noun, noun adjective, compounds, possessive and adverb as pre modifier
  - ii. Introducing infinitive phrase, present participle phrase, past participle phrase, prepositional phrase, appositive, adjective, relative clause, adverb as post modifier
- d) Preposition
  - i. Introducing simple, compound, phrase and participle prepositions
  - ii. Showing and practicing the meaning and use of phrase prepositions
  - iii. Showing difference in use of some common preposition
  - iv. Discussing appropriate preposition
- e) Verbs
  - i. Introducing transitive and intransitive verbs
  - ii. Introducing strong and weak verbs and conjugation of common verbs
  - iii. Causative verbs
  - iv. Group verbs

**2. (Reading-1, for general topics) - Seen passages from-**

- Exercises in Reading Comprehension  
Edited by: E.L. Tibbits  
Longman Group Limited, Longman House  
Burnt Mill, Essex, UK
- Build up Your English, A.J. Glover, The English Language Book Society and J.M. Dents and Sons Ltd. London
- The Pilgrim's Progress (selected passages)  
John Bunyan  
William Collins Sons and Co. Ltd. London (part one)
- The Old Man and the Sea (selected passages)  
Ernest Hemingway  
Peacock Books  
B-2, Vishal Enclave, New Delhi-110027

**Activities:**

- Vocabulary (synonym/antonym/formation of sentences with words/filling in the gaps)
- Comprehension (short question to be answered in one sentence/true/false)

- Grammar: (identifying parts of speech/writing own sentence following certain structure/identifying grammar points taught in chapter-1)

### 3. (Reading -2, reading for inculcating moral values) - Unseen

Some passages on 'honesty, truthfulness, God fearing, helping the distressed people, refraining from bad conducts' will be given and students after reading the passages will-

- Work in pairs and groups to discuss the content
- Make a speech on the content
- Write an e-mail to friend/relative on the topic

### Section-B (Final Exam: 50 Marks)

**Grammar:20, Writing: -15, Speaking-10, Listening -05**

#### 1. (Basics of Grammar)

##### a) Conjunction

- Discussing the difference between preposition and conjunction
- Showing the meaning and use of compound conjunctions like, in order that, on condition that, even if, so that, provided that, as though, as well as, as soon as, as if.
- Introducing coordinating conjunctions like, and, but, for, or, nor, also, either----or, neither----nor
- Use of subordinating conjunctions like, after, because, if, that, though, although, till, before, unless, as, when, where, while.

##### b) Subject and verb agreement

##### c) Idioms and phrases

##### d) Voice

- Discussing the difference between active subject and passive subject.
- Discussing ways of transforming active into passive and passive into active.
- Showing the right use of verb with active and passive subject

##### e) Narration

##### f) Formation of WH question

##### g) Tenses

- Introducing use of 'to be' and 'to have' in three tenses with affirmative, negative, interrogative (both Yes/No and WH) structures.
- Discussing structures and uses of different tenses with action verbs like 'read, write, play, discuss' etc.
- Discussing ways of identifying different forms of tenses and showing right use of verbs
- Exploring students' difficulties in the use of tense, correcting and discussing tense based errors.

#### 2. Writing:

- Writing academic applications
- Writing e-mail, Facebook status, WhatsApp/Imo/Viber messages
- Writing story on the basis of theme/ completing story
- Writing news casts
- Describing pie/column chart/graphs
- Guided paragraphs
- Agreeing/disagreeing on some opinion
- Amplification of ideas

- Writing dialogue from a passage

### 3. Speaking:

- Making speech
- Pair work
- Group work
- Debate

### 4. Listening and Speaking:

- To let the students listen various recorded dialogues or part of English movies to develop their listening skills.
- To arrange classes to let the students describe pictures or Cartoons, different topics. Extempore speech and Set speech to accelerate their fluency in English.

#### Recommended Books:

1. Raymond Murphy, *Intermediate English Grammar*, Foundation Books, 2/19 Ansari Road, Daryaganj, New Delhi-110002, Manas Saikia, 1995. (Published by arrangement with Cambridge University Press, The Edinburgh Building, and Shaftsbury Road, Cambridge CB2 2RU, U.K).
2. Wren and Martin, *High School English Grammar and Composition*, New Delhi, S. Chand and Company Ltd. 2002.
3. Thomson and Martinet, *Practical English Grammar*, Oxford University Press, Walton Street, Oxford OX2 6DP, 1993 (reprinted in India by arrangement with Oxford University Press).
4. Michael A. Pyle and Mary Ellen Munoz, *Cliffs TOEFL Preparation Guide*, New Delhi, BPB Publications, B-14, Connaught Place, New Delhi-110001, 1992.
5. Bruce Rogers, *Peterson's TOEFL Success*, Princeton, New Jersey, Peterson's, 2000.
6. AS Hornby, *Oxford Advanced Learner's Dictionary of Current English*, Oxford University Press, 2002-2003.
7. Chowdhury and Hossain, *Advanced English*, Dhaka, Sayma Chowdhury and Halima Chowdhury, 2004.
8. Build up Your English, A.J. Glover, The English Language Book Society and J.M. Dents and Sons Ltd. London.

<b>Course Code: UREM-1101</b>		
<b>Course Title: Text of Ethics and Morality</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

#### Course Objectives:

- To make students capable of understanding the text of the Holy Qur'an so that they can understand the rules of ethics from the main and basic ethical book.
- To make students capable of understanding the basic Arabic language so that they can communicate with the foreign countries and be fit with labor market worldwide especially in the Middle East.
- To inspire students and make them interested in reading the Holy Qur'an, the basic ethical book, the last divine scripture and the complete code of life.
- To make students familiar with Ayats of Ahkam of the Holy Qur'an so that they can lead their life being enlightened with them.
- To go towards achieving the motto of the university – to combine quality with morality.

#### Course Outcomes:

- The recitation of the Holy Qur'an properly following the rules of recitation.
- The meaning of the significant words and expression mentioned in the text.
- Understanding the formation of Qur'anic verses as per Arabic language.
- Central theme and subject matter of the text.
- Teachings and implication of the text.
- Comparison between the requirements of Ayats and the reality of our life.
- Understanding basic formation of Arabic sentences.

- Obtaining the capability of Arabic conversation.

### Section-A (Mid-term Examination: 30 marks)

1. An introduction to the text of Ethics and Morality.
2. An introduction to Arabic language; Arabic alphabet, *harakah*, *tanween*, *sukun* and *tashdeed*.
3. Text of ethics and Arabic language lesson (25m+20m).
  - a) Selected text on the introductory chapter of the holy Qur'an (*suratulFatihah*).
  - b) Writing of the forms of Arabic alphabet with example. (Assignment).
4. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on procreation of the creation of humankind: 22:5
  - b) The sun letters and the moon letters.
5. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on *iman*: 2: 1-5
  - b) Arabic numbers (10-100).
6. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on *twheed*: 112: 1-4
  - b) Some common Arabic words used in daily life (20 words).
7. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on *resalah*: 4: 163-165.
  - b) The name of days in Arabic.
8. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on *akhirah*: 39: 68-74.
  - b) The name of months in Arabic.
9. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on *taharah*: 5:6.
  - b) The formation of Arabic word; noun, verb and particle.
10. Text of ethics, and Arabic language lesson (20 m+20m).
  - a) Selected text on *salah*: 11: 114, 24: 68.
  - b) Exercise of Damaaer (الضَّمَائِر): pronouns.
11. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on Zakat: 9: 34-35.
  - b) Exercise of Arabic relative pronouns.
12. Text of ethics, and Arabic language lesson (25 m+20m).
  - a) Selected text on Sawm : 2: 184-185.
  - b) Exercise of demonstrative pronouns. (إسم الإشارة)

### Section-B (Final examination: 50 marks)

13. Text of ethics and Arabic language lesson (25 m+25m).
  - a) Selected text on hajj and Ka'ba 2: 127-128; 3: 96-97.
  - b) Practice of *huruf al-jarr* (حروف الجار): prepositions.
14. Text of ethics, and conversation (25 m+20m).
  - a) Text on ensuring social peace by removing bad behavior 49:5-12
  - b) Conversation: myself and my family members.
15. Text of ethics, Arabic language lesson and conversation (20 m+15m +10 m).
  - a) Selected text on duties and obligations towards family and relatives = 4: 34-36.
  - b) Exercise of adverb of time and place (ظرف الزمان والمكان).
  - c) Conversation: at the house.
16. Text of ethics, Arabic language lesson and conversation (20 m+15m +10 m).
  - a) Selected text on the operation of creatures in the universe. 2:164.
  - b) Exercise of simple nominal sentence (الجملة الإسمية)
  - c) Conversation: at the university
17. Text of ethics, Arabic language lesson and conversation (25 m+15m +10 m).
  - a) Selected text on the transition of human life: 10:24

- b) Subject of a sentence ( المبتدأ )  
 c) Conversation: about the weather.
18. Text of ethics, Arabic language lesson and conversation (20 m+15m +10 m).  
 a) Selected text on the rule of livelihood = 2: 172- 174, 5:3-5  
 b) Predicate of a sentence ( الخبر )  
 c) Conversation. At masjid.
19. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected text on the rule of *al-riba* = 2: 275-279.  
 b) Exercise of interrogative pronoun إسم الاستفهام  
 c) Conversation : at library
20. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected text on the rule of loan =2: 282.  
 b) Exercise of possessive phrase المركب الاضافي  
 c) Conversation : at kitchen
21. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected Text on the rules of drug and gambling =5: 90-91  
 b) Exercise of descriptive phrase المركب التوصيفي  
 c) Conversation: at market.
22. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected Text on the rule of veil and *mahram* (unmarriageable persons) : 24: 30-31,33:59  
 b) Formation of Verb الفعل -1  
 c) Conversation: at stadium.
23. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected Text on the rule of marriage and *mahr*: 4: 2-4  
 b) Formation of Verb الفعل -2  
 c) Conversation: the visiting to a sick man.
24. Text of ethics, Arabic language lesson and conversation (20 m+15m +10 m).  
 a) Text on the rule of divorce 2:227-230  
 b) Formation of Verb الفعل -3.  
 c) Conversation: at relative's house.
25. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected text on *kufr*, *shirk* and *nifaq*=5:72, 9:68  
 b) Formation of Verbal sentence الجملة الفعلية  
 c) Conversation: performing salat.
26. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 a) Selected text on the sermon of a father to his son =31:13-19.  
 b) Exercise of Verbal sentence الجملة الفعلية -1  
 c) Conversation: giving *zakah* and *sadakah*.
27. Text of ethics, Arabic language lesson and conversation ( 20 m+15m +10 m).  
 (a) Selected text on characteristics of Allah's servants who are inheritors of *Jannah*= 23:1-11  
 (b) Exercise of Arabic imperative sentence.  
 (c) Conversation: Conversation: Eidfestival and performing hajj.
28. Text of ethics, Arabic language lesson and conversation (25m+20m).  
 a) Selected text on characteristics of ideal servants of Allah ('IbadurRahman) as depicted in the Qur'an= 25: 63-76  
 b) Formation and exercise of Arabic negative imperative sentence.

#### Recommended Books:

1. Abbott, N., Studies in Arabic literary papyri II, Qur'anic commentary and tradition, Chicago: University of Chicago, 1967.
2. Dr. M. FazlurRahman, Everyday Arabic Conversation, RiyadProkashani, Dhaka, 2005.
3. Haleem, M. A., Understanding the Qur'an: themes and Style, London: I. B. Tauris, 1999.
4. IzzathUroosa, Learning Arabic Language of the Qur'an, Darussalam, Riyadh, 2010.
5. Saheeh International, The Qur'an Arabic Text with Corresponding English Meanings, Jeddah, Saudi Arabia, 1997.

## Second Semester

<b>Course Code: PHARM-1201</b>		
<b>Course Title: Organic Pharmacy</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide core knowledge for understanding basic aspects of organic chemistry, mechanism and synthetic applications of some named reactions, methods of preparation, test for purity, important medicinal uses of some important organic compounds.

**Course Outcomes:** Upon successful completion of the course, students will be able to:

- Understand IUPAC/Common system of nomenclature of simple organic compounds.
- Describe detailed mechanisms for common reactions and their applications.
- Know methods of preparation, physicochemical properties and pharmaceutical applications of some organic compounds like lipid, protein and carbohydrates.

### Section-A (Mid-term: 30 Marks)

- 1. Introduction:** Saturated and unsaturated hydrocarbons, polarity of bonds, carbonium and carbanions, free radicals; inductive, mesomeric, electromeric and hyperconjugative effects; electrophile and nucleophile etc.
- 2. Aliphatic Compounds:**
  - a) **Alkanes, Alkenes and Alkynes:** Brief idea, identification and pharmaceutical applications.
  - b) **Aldehydes and Ketones:** Introduction, methods of preparation, physical and chemical properties and pharmaceutical applications.
  - c) **Alcohols:** Introduction, methods of preparation, physical and chemical properties and pharmaceutical applications.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Aromatic Compounds:** Definition, nomenclature, sources, preparations of aromatic compounds. Structure (Kekule formula), resonance, aromaticity, Huckel's rule; synthesis, physical and chemical properties and uses of benzene.
- 4. Reaction Mechanisms:** Addition reaction, substitution reaction and elimination reaction.
- 5. Amines:** Introduction, methods of preparation, physical and chemical properties and pharmaceutical applications.
- 6. Carboxylic acids:** Introduction, methods of preparation, physical and chemical properties and pharmaceutical applications.

#### Group-B (30 Marks)

- 7. Lipids:** Definition, classification, properties and pharmaceutical importance. Fats, oils and waxes: natural sources, extractions, refining of crude fats and oils, physical and chemical properties, tests of fats and oils, detergent, cleansing mechanism of soap and detergent.
- 8. Amino Acids and Proteins:** Definition, nomenclature, classification, structure, synthesis, physical and chemical properties (acidity, basicity, isoelectric point), reactions (amino acids- deamination, transamination, racimization). Peptides and proteins: tests, isolation, purification and determination; pharmaceutical importance.
- 9. Carbohydrates:** Definition, classification, properties, qualitative tests and pharmaceutical importance. Monosaccharides, Disaccharides and Polysaccharides: nomenclature, classifications, synthesis and inter-conversions, general reactions, stereochemistry

(enantiomers, optical isomers, mutarotations, racemic mixture) configurations and pharmaceutical importance of glucose, fructose, sucrose, lactose, maltose, sweeteners (saccharin, nectarin, cyclamate) and starch, cellulose, inulin).

**Recommended Books:**

1. Delgado, J.N and Remers, W.A (1998) *Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 10<sup>th</sup> ed. Lippincott Williams and Wilkins.
2. Bahl, A. and Bahl, B.S (2005) *Advanced Organic Chemistry*. S.Chand and Sons.
3. Morrison, R.T and Boyd, R.N (2002) *Organic Chemistry*, 6<sup>th</sup> ed. Prentice-Hall.
4. Finar, I.L (2002) *Organic Chemistry* Volume 1 and 2, 6<sup>th</sup> ed. Pearson.
5. Ahmed, M. and Jabbar Mian, A. (1965) *Textbook of Organic Chemistry*. Dhaka.
6. Abraham, D.J, (2003) *Burger's Medicinal Chemistry and Drug Discovery*, 6<sup>th</sup> ed. John Wiley and Sons.
7. Lamke, T.L et.al (2008) *Foye's Principles of Medicinal Chemistry*, 6<sup>th</sup> ed. Lippincott Williams and Wilkins.
8. King, F.D (2002) *Medicinal Chemistry: Principles and Practice*, 2<sup>nd</sup> ed. The Royal Society of Chemistry.
9. Patrick, G.L (2013) *An Introduction to Medicinal Chemistry*, 5<sup>th</sup> ed. Oxford University Press.

<b>Course Code: PHARM-1202</b>		
<b>Course Title: Organic Pharmacy Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical knowledge about systematic and qualitative analysis of known and unknown organic compounds and identification of pharmaceutical compounds.

**Course Outcomes:** At the end of the course, the student will be able to:

- Determine melting and boiling point of different organic compounds.
- Identify functional groups of organic compounds.
- Know techniques of organic synthesis.

**Experiments:**

1. Systematic qualitative analysis and fusion of organic compounds and specific test for elements.
2. Determination of melting and boiling point and the survey of solubility with different solvents.
3. Identification and confirmation of functional groups: -COOH, -OH, >C=O, -NH<sub>2</sub>, -NO<sub>2</sub>.
4. Systematic qualitative analysis of organic compounds:
  - a) Benzoic acids
  - b) 2,4-dinitrophenyl hydrogen
  - c) 2-chloro benzoic acids, salicylic acid
  - d) benzyl-4-nitrobenzoic acid
  - e) 4-amino benzoic acid etc
5. Identification of aspirin in tablet.
6. Identification of paracetamol in tablet.
7. Identification of paracetamol in syrup.
8. Identification of para amino benzoic acid (PABA).
9. Identification of tetracycline in tablet.
10. Identification of tetracycline in capsule.
11. Identification of metronidazole in tablet.
12. Synthesis of simple organic compounds using name reactions.
13. Synthesis of alcohol and ester.

<b>Course Code: PHARM-1203</b>		
<b>Course Title: Pharmacognosy and Phytochemistry-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To understand the scope, classification of crude drugs, their identification, evaluation and phytochemicals present in them and their medicinal properties. The subject also involves the modern extraction, isolation and purification techniques of phytoconstituents.

**Course Outcomes:** Upon completion of the course, the student will be able to:

- Know techniques in the cultivation, collection and storage of crude drugs.
- Gain knowledge relating to phytochemicals of crude drugs and their therapeutic uses.
- Know evaluation, extraction and separation techniques for the herbal drugs.

### **Section-A (Mid-term: 30 Marks)**

- 1. Introduction:** Definition, terminology (biological source, geographical source, habit, habitat, morphology, histology, native and indigenous), scope of pharmacognosy, historical developments.
- 2. Crude Drugs:** A general view of their origin, distributions, cultivation, collection, drying and storage, commerce and quality control.
  - a) Classification of drugs
  - b) Preparation of drugs for commercial market
  - c) Evaluation of crude drugs
  - d) Drug adulteration
- 3. Carbohydrate and Related Compounds:** Definition, classification, tests of carbohydrates. Synonyms, sources, habitats, collections and preparations, characteristics, chemical constituents and pharmaceutical and medicinal uses of- sugars and sugar containing drugs: glucose, fructose, sucrose, dextrose, etc; polysaccharides and polysaccharide containing drugs: starch, dextran etc; gums and mucilage: tragacanth, acacia, sterculia, sodium alginate, agar and cellulose.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 4. Vitamins and Vitamin Containing Animal Drugs:** Definition, classification, sources, properties, medicinal uses of cod liver oil, shark liver oil, hilsa fish liver oil etc.
- 5. Lipids:** Definition, classification, tests of lipids. Synonyms, sources, habitats, collections and preparations, characteristics, chemical constituents and pharmaceutical and medicinal uses of- castor oil, linseed oil, coconut oil, olive oil, peanut oil, chaulmoogra oil and bees wax.

#### **Group-B (30 Marks)**

- 6. Alkaloids:** Distribution, properties, tests, extraction, structural types and classification. Study of biological sources, geographical sources, chemical constituents and uses of areca, hemlock, conium, hyoscyamus, belladonna, stramonium etc.
- 7. Phytochemistry:** Extraction, separation, chromatography, types of plant constituents, comparative phytochemistry and chemotaxonomy. Pharmaceutical uses of the following plant constituents along with consideration of some important drugs of each group.
- 8. Surgical Dressings and Fibers:** Classification, importance and brief study of different types of surgical dressings and fibers: cotton, silk, hemp, wool, methyl cellulose, cellulose acetate, alginate fibers, nylon etc.

**Recommended Books:**

1. Tyler, V.E, Brady, L.R and Robbers, J.E (1982) *Pharmacognosy*. Lea and Febiger.
2. Evans, W.C (2002) *Trease and Evans' Pharmacognosy*. Saunders/Elsevier.
3. Wallis, TE (2005) *Textbook of Pharmacognosy*. Churchill Livingstone/Elsevier.
4. Zafar, R, Gandhi, N (2007) *Practical Pharmacognosy*. CBS Publishers and Distributors.
5. Ikan, R (2013) *Natural Products: A Laboratory Guide*, 2<sup>nd</sup> edition. Academic Press/Elsevier.
6. Ghani, A. (2005) *Textbook of Pharmacognosy*. Institute of Medical Technology.
7. Ali, M. (1998) *Textbook of Pharmacognosy*, 2<sup>nd</sup> ed. CBS Publishers.
8. Ghani, A. (2011) *Medicinal Plants: Chemical Constituents and Uses of Medicinal Plants of Bangladesh*. Lambert.
9. Basu, B.D, *Indian Medicinal Plants: Plates*.

<b>Course Code: PHARM-1204</b>		
<b>Course Title: Pharmacognosy and Phytochemistry-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To familiar with the origin, morphology, histology, constituents and uses of herbal drugs; identification and isolation of phyto constituents.

**Course Outcomes:** At the end of the course, the student will be able to:

- Identify crude drugs by morphological, organoleptic and histological characters.
- Isolate chemical constituents from crude drugs.
- Test for the identification of carbohydrates, proteins etc.

**Experiments:**

1. Study of various crude drugs (leaf, bark, bud, seed, flowers).
2. Identification of medicinal plants and their taxonomy.
3. General test for carbohydrate: Glucose, Fructose
4. General test for carbohydrate: Sucrose, Lactose
5. Physical and chemical test for starch.
6. General chemical test (Iodine test) for polysaccharide
7. Pentose test for pentose sugar (Ribose)
8. Isolation of casein and albumin from milk powder

<b>Course Code: PHARM-1205</b>		
<b>Course Title: Physical Pharmacy-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To make the students understand the factors influencing the stability and methods for monitoring processes of pharmaceutical preparations as well as properties of colloidal systems.

**Course Outcomes:** On successful completion of the course, students will be able to:

- Understand physicochemical properties of drugs including solubility, distribution, adsorption, and stability.
- Recognize basic rules and equations regarding physical principles essential for pharmaceutical applications.
- Explain rheology, dispersed systems and electrochemistry.

**Section-A (Mid-term: 30 Marks)**

1. **Rheology and Rheology of Dispersed Systems:** Newtonian liquids, Non- Newtonian materials, yield value, plastic and pseudoplastic flow, dilatant and thixotropic flow, viscosity of suspending agents.

2. **Adsorption and Interfacial Phenomena:** Freundlich and Langmuir isotherms, BET equation. Electrical properties of interfaces, electrical double layer, Nernst and zeta potential, Gibbs equation. Spreading, surface active agents, emulgents, detergents and antifoaming agents, surfactants and drug activity. Surfactants and pharmaceutical products.

**Section-B (Final Exam: 50 Marks)**  
**Group-A (20 Marks)**

3. **Solubility and Distribution Phenomena:** General Principles, solvent-solute interaction, solubility of liquids in liquids, distribution of solutes between immiscible solvents.
4. **Reaction Kinetics and Stability of Pharmaceuticals:** Definitions, rates and orders of reactions, methods for determination of orders of reactions, influence of temperature on rate of reactions, theories of reaction rates, decomposition of pharmaceutical products, accelerated test for physical, chemical and photo-chemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination.

**Group-B (30 Marks)**

5. **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 preparations in pharmacy.
6. **Electrochemistry:** Electrical units and their interrelation, Faradays laws of electrolysis and electrochemical equivalents; electrolytic conduction, equivalent conductance and the related facts, conductometric titrations, transference numbers and their determination.
7. **Electrochemical Cells:** Electrode and cell potentials, energies involved in electrode processes; reference electrodes, buffer solutions and measurement of pH; potentiometric titrations and oxidation reduction systems, concentration cells.

**Recommended Books:**

1. Saiko, P. J (2006) *Martin's Physical Pharmacy*, 4<sup>th</sup> ed. Lippincott Williams and Wilkins.
2. Haque, M.M, and Nawab, M.A (2009) *Principle of Physical Chemistry*. Brothers Publications.
3. Bahl, A, Bahl, B.S, Tuli G.D (2000) *Essentials of Physical Chemistry*, S.Chand and Company.
4. Glasstone, S. and Lewis, D. (1960) *Elements of Physical Chemistry*. Macmillan.
5. Atkins, P, de Paula, J, Keeler, J. (2017) *Atkins' Physical Chemistry*, 11<sup>th</sup> ed. Oxford University Press.
6. Alexeyev, V. (2005) *Quantitative Analysis*. CBS Publishers.
7. Florence, A. T, Attwood, D (2011) *Physicochemical Principles of Pharmacy*, 5<sup>th</sup> ed. Macmillan.

<b>Course Code: PHARM-1206</b>		
<b>Course Title: Physical Pharmacy-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge about physicochemical behaviors of pharmaceutical compounds.

**Course Outcomes:** By the end of the course, the student will be able to:

- Determine various physical properties such as surface tension, viscosity, adsorption, distribution co-efficient and solubility.
- Standardize secondary standard substances.
- Determine of pH and molecular weight of organic compound.

**Experiments:**

1. Enlisting of glass wares used in physical pharmacy practical classes and precautions to be taken during handling.

2. Determination of viscosity.
  - a) Determination of viscosity of pure liquids such as glycerin, alcohol etc.
  - b) Determination of viscosity of pharmaceutical preparations: syrup, emulsion, suspension etc.
  - c) Study of variation of viscosity of liquid with temperature using Ostwald of Engleris viscometer.
3. Determination of heat of neutralization between a strong base and a strong acid.
4. Determination of distribution co-efficient of benzoic acid between ether and water.
5. Determination of absorption isotherm of oxalic acid by charcoal.
6. Determination of equilibrium constant of reaction,  $KI + I_2 \rightleftharpoons KI_3$ .
7. Standardization of  $Na_2S_2O_3$  solution by standard  $K_2Cr_2O_7$  solution.
8. pH metric titration of an acid by a base.
9. Determination of the molecular weight of an organic compound.

<b>Course Code: PHARM-1207</b>		
<b>Course Title: Human Physiology-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To facilitate a basic understanding of the structure, functions and control mechanisms of human body systems. The body systems dealt with blood, digestive system, cardiovascular system and respiratory system.

**Course Outcomes:** After completion of the course, the student will be able to:

- Explain physiology of body fluids, blood and lymphatic system and associated disorders.
- Understand anatomy, physiology and functions of digestive and respiratory system.
- Know anatomy and physiology of cardiovascular system and associated disorders.

### **Section-A (Mid-term: 30 Marks)**

1. **General Physiology:** Definition of physiology, importance of physiology, composition of body, body control mechanism, positive and negative feedback mechanism, regulation of body, membrane transport, ion channel etc.
2. **Blood System:**
  - a) **Blood:** Composition and functions
  - b) **Plasma:** Electrolytes, proteins and other organic constituents.
  - c) **Blood cells:** Formation and destruction cell count, functions of different blood cells.
  - d) **Hemoglobin:** Structure, properties and function.
  - e) **Anemia:** Causes, classification and clinical features of various types of anemia.
  - f) **Blood Coagulation:** Blood groups, blood transfusion.
  - g) **Lymph:** Composition, formation, circulation and function, lymph nodes and lymphatic.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

3. **Digestive System:**
  - a) **GIT:** Structure of the different parts of the alimentary system, movements of the different parts of the alimentary tract and their control, swallowing, gastric contractions, intestinal contractions, defecation secretion of digestive juices, saliva, gastric juice, pancreatic juice, intestinal juice and bile, mechanism and control of the various secretions and their functions, digestion of foodstuff. Absorption of the different digested materials.

- b) Liver:** Structure and functions of liver, formation of bile and its concentration in the gall bladder, circulation of bile salts and bile pigments, functions of liver.

### Group-B (30 Marks)

#### 4. Cardiovascular System:

- a) Heart:** Structure and properties of cardiac muscles, conduction system of heart, cardiac cycle, heart sound, heart rate, heartbeat, cardiac output and ECG.
- b) Blood vessels:** Type of blood vessels and their function.
- c) Blood pressure:** Measurements and regulation of B.P., control of B.P. (neural and humoral), importance and functions.

- 5. Respiratory System:** Functional anatomy of the respiratory system, mechanism of respiration, lung volumes and capacities, gaseous exchange and transport (O<sub>2</sub> and CO<sub>2</sub>); regulation of respiration (nervous and chemical); hypoxia- causes and classification; periodic (abnormal) breathing, Chenestokes breathing, Kussmal breathing and breathing at high altitude.

#### Recommended Books:

1. Guyton, A.C and Hall, J.E (2005) *Textbook of Medical Physiology*, 11<sup>th</sup> ed. Saunders/Elsevier.
2. Chatterjee, C.C (2016) *Human Physiology* (Volumes I and II), Revised 11<sup>th</sup> ed. CBS Publishers.
3. Barrett, K.E, et.al (2005) *Ganong's Review of Medical Physiology*, 22<sup>th</sup> ed. Lange/McGraw-Hill.
4. Ghai, C.L (2012) *A Text Book of Practical Physiology*, 8<sup>th</sup> ed. Jaypee Brothers.
5. Standring, S. (2008) *Gray's Anatomy*, 40<sup>th</sup> ed (International student's edition). Churchill Livingstone.
6. Costanzo, L.S (2014) *Physiology*, 6<sup>th</sup> ed (Board Review Series). Lippincott Williams and Wilkins.
7. Keele, C.A, Neil, E, Joels, N (1992) *Samson Wright's Applied Physiology*, 13<sup>th</sup> ed. Oxford University Press.
8. Ahmed, K.M. *Physiology of Blood*, 2<sup>nd</sup> ed. Hafiz Books.

<b>Course Code: PHARM-1208</b>		
<b>Course Title: Human Physiology-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge for determination of various physiological parameters.

**Course Outcomes:** At the end of the course, the student will be able to:

- Determine blood group, Rh typing, clotting and bleeding time.
- Estimate RBC, WBC, hemoglobin.
- Familiar with different common health instruments.

#### Experiments:

1. Introduction to physiology lab and instruments and study of microscopy.
2. Determination of blood grouping and Rh typing.
3. Determination of clotting time.
4. Determination of bleeding time.
5. Determination of prothrombin time and INR.
6. Estimation of ESR.
7. Counting cell and determined total number of blood cells.
8. Total count of R.B.C, W.B.C.
9. Estimation of blood hemoglobin level.

<b>Course Code: PHARM-1213</b>		
<b>Course Title: Oral Assessment-I</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 00</b>	<b>Total Hours: 00</b>

**Course Objectives:**

- To ensure comprehension of the topics covered in class and in the reports.
- To improve students' presentation and communication skills.
- To preparing students for the types of oral assignments required in future linguistic course.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain deeper insights on the topics covered courses.
- Enhance students' self-confidence for the future viva-voce.

**Course Contents:** Previous courses of this syllabus, basic knowledge and miscellaneous.

<b>Course Code: MATH-1201</b>		
<b>Course Title: Fundamentals of Mathematics</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To able problem solving and logical skills and to know the theory and applications of mathematics in pharmacy.

**Course Outcomes:** At the end of the course, the student will be able to:

- Relate theory and applications of basic mathematics with pharmacy.
- Solve common pharmacy calculations using mathematical skills.

### **Section A (Midterm Exam: 30 Marks)**

- 1. Basic Arithmetic:** Integers, fractions, exponents and roots, decimals, real numbers, ratio, percent.
- 2. Basic Algebra:** Algebraic expressions, rules of exponents, solving linear equations, solving quadratic equations, solving linear inequalities.
- 3. Linear Algebra:** Vector: Fields of scalars, Vector spaces and subspaces. Matrices: addition, subtraction and multiplication; unit matrix, row transformation, determinants, inverse of matrix and solution of equations by matrix.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

#### **4. Graphs and Gradients:**

- a) Rectangular co-ordinates, curve fitting using first degree equation in both variables, determination of slope and intercept and point of intersection, equation of first degree in both x and y (circle), ellipse, rectangular hyperbola etc.
- b) Exponential and logarithmic curves, graphical solution of equation, graphical solution of simultaneous equations.
- c) Arithmetic progression, geometric progression, permutation-combination, binomial theorem, exponential theorem.
- d) Pharmaceutical application of curve fitting method in expressing degradation of drugs.

#### **Group-B (30 Marks)**

- 5. Functions:** Limit of Functions, continuity and differentiability, physical meaning of derivative of a function, Indeterminate form.
- 6. Calculus:**

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

**Recommended Books:**

1. ETS (2017) *Math Review: for the Quantitative Reasoning Measure of the GRE General Test*. Educational Testing Service, USA.
2. Thomas, G.B and Finney, R.L (1995) *Calculus and Analytic Geometry*, 9<sup>th</sup> ed. Addison Wesley.
3. Shahidulla , Bhattacharjee - A text book on Coordinate Geometry and Vector Analysis
4. Seymour Lipschutz- Set Theory and Related Topics
5. Abu Yousouf- Differential Calculus
6. K. A. Stroud- Engineering Mathematics
7. R. Spigel- Mathematical Handbook of Formulas and Tables
8. Murry, R. Spigel and Robert Moyer- College Algebra
9. Coordinate Geometry- Dash and Mukherzee
10. A Textbook of Integral Calculus- Dash and Mukherzee.

<b>Course Code: URED-1201</b>		
<b>Course Title: Basic Principles of Islam ('Aqidah+'Ibadah)</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:**

- To provide the students with proper knowledge and clear conception regarding the Islamic beliefs and comprehensive concept of 'Ibadah to develop their ethical understanding.
- To make them aware of the existing misconceptions and traditional superstitions contradicting with the basic faith and tenets of Islam.
- To enable the students to have the wide spread impacts of 'Ibadah on their lives and to inspire them to follow Islam in all walks of life.

**Course Outcomes:** After completion of this course:

- The students will be equipped with the knowledge and clear conception regarding the Islamic beliefs and comprehensive concept of 'Ibadah.
- They find themselves ethically developed ones.
- They will have inspiration to live their lives in accordance with Islamic guidance.

**Section-A (Mid-term: 30 Marks)**

1. **Islam- An introduction:** (a) Islam: its definition and characteristic (b) Islamic 'Aqidah: its definition and importance.
2. **Articles of Faith (Pillars of Iman):**
  - a) **Believe in Allah (Swt):** (1) Existence of Allah (Swt) (2) Tawhid: Definition and classifications (Tawhid Al-Rabubiah, Tawhid Al-Uluhiyyah and Tawhid Al-Asma Was-Sifat) (3) Impact of Tawhid.
  - b) **Shirk:** (1) Definition, classifications and consequences (2) Examples of some Shirks in the contemporary society.
  - c) **Belief in Allah's Angels (Malaikah):** (a) Belief in Angels of Allah (SWT): Its meaning, their Nature and Functions (b) Benefits of belief in Angels.
  - d) **Belief in the Books of Allah:** (a) Belief in the Books of Allah: Its meaning and an introduction to the revealed Books and Scriptures (b) The position of the Holy Qur'an amongst the other revealed Books (c) Benefits of belief in the Books of Allah (SWT).
3.
  - a) **Belief in Allah's Prophets:** (a) Belief in Allah's Prophets: Its meaning and purpose of their sending (b) Features of Prophethood and Contributions of the Prophets towards the

Humanity (c) Muhammad (SAAS) is the greatest, the best and the last among all the Prophets and Messengers.

- b) **Belief in the Akhirah (Life After Death):** (a) Definition and Stages of Akhirah (b) The logic and evidence regarding Akhirah (c) Impact and benefits of belief in Akhirah.
- c) **Belief in Qadr/ Taqdir (Fate) and divine decree:** (a) Definition of belief in Qadr/ Taqdir (b) Opinions of the scholars regarding Taqdir (c) Concept of man's freedom of will in Islam.
- d) **The nullifiers of Iman:** (a) Kufr and Nifaq: Definition, classifications and consequences (b) Description of the nullifiers of Iman in details.

### Section-B (Final Exam: 50 Marks)

4. **Ibadah: Its introduction:** (a) Meaning of *Ibadah* (b) Various types of *Ibadah* (c) The best *Ibadah* (d) Objectives and aims of *Ibadah*. (e) Conditions of *Ibadah*.
5.
  - a) **Characteristics of *Ibadah* and signs of *IbadurRahman*:** Characteristics of *Ibadah* in Islam: Free from Intermediaries, Not being confined to specific places, All-Embracing View (Scope of *Ibadah*)...etc.
  - b) **Signs of *IbadurRahman* (Servant of Ar-Rahman):** According to the holy Qur'an.
  - c) ***Taharah* and *Najasah*:** Definition of *Taharah* (purity) and *Najasah* (impurity). Ways and means of *Taharah*: *Wadu*, *Gusl*.
6. **Some Articles of Islam (Pillars of Islam) and Defense system of Islam:**
  - a) ***Salah* (Prayer): Its significance, teachings and some basic rules:** (a) Definition and kinds (b) Importance (c) Pre requisites of *Salah* (*Shurutus-Salah*) (d) Essentials/ Basic components of *Salah* (*Arkanus-Salah*) (e) How to perform the *Salah* in detail (practically)? (f) Things that invalidate the prayer (*Mufsidatus-Salah*) (g) *Sajdah* that makes prayer correct (*Sajdatus-Sahu*) (h) Friday prayer (*Salatul-Jumu'ah*) (i) The funeral prayer (*Salatul-Janazah*) (j) Prayer of the traveler (*Salatul-Musafir*) (k) '*Eid* prayer (*Salatul-'Eid*) (l) Impact of *Salah*.
  - b) ***Zakah* (poor due) : Its significance, teachings and some basic rules:** (a) Definition and types (b) Importance (c) kinds of property on which *Zakah* is obligatory (d) Who should give *Zakah* (e) Due recipients of *Zakah* (f) *Zakah* and poverty alleviation (g) Impacts/ benefits of *Zakah*.
  - a) ***Sawm* (Fasting): Its significance, teachings and some basic rules:** (a) Definition and types (b) Importance (c) Things which invalidate the fast (*Mufsidatus-Sawm*) (d) Who must fast? (e) Exemption from fasting (f) Recompense of mistake (*Qada* and *Kaffarah*) (g) *SadqatulFitr/ ZakatulFitr* (h) Impact of *Sawm*.
  - b) ***Hajj* (pilgrimage): Its significance, teachings and some basic rules:** (a) Definition and types (b) Importance (c) How to perform *Hajj* in detail? (d) Impact of *Hajj*.
7. **Defense system of Islam:** (a) Definition and classification of *Jihad* from various aspects (b) Importance of *Jihad* (c) Differences between *Jihad* and Terrorism.

#### Recommended Books:

1. Rafique Dr. Abu Bakr, *Islam The Ultimate Religion (Book one) Islamic 'Aqidah'*, Chittagong: ABC Publications, 2002.
2. Mohammad Shafiul Alam Bhuiyan, *The Fundamental Beliefs of a Pure Muslim*, 1<sup>st</sup> edition, 2003.
3. Sabiq, Assayed, *Al-'Aqeed Al- Islamiyah, Cairo, Al-Fathu Lil-IelamilArabi*, 10th edition-2000.
4. Bilal Philips, Dr. Abu Ameenah. *The Fundamentals of Thwhid (Islamic Monotheism)*, International Islamic Publishing House.
5. Farid, Ahmed, *An Encounter with Islam*, Dhaka: Islamic Foundation, Baitul Mukarram, Dhaka, 1995.
6. Mohammad AmimulAhsan and others, *Towards Understanding `Ibadah in Islam*, Bangladesh Institute of Islamic thought (BIIT), Humanscience Series-06, First Eddithion, May-2015.
7. Abdalati, Hammudah, *Islam in Focus*, The Dept. of Islamic Affairs, The Ministry of Awqaf and Islamic Affairs, State of Qatar, 1995/ Islamic Teaching Course. Vol.-1
8. Al-Quardawi, Dr. Yousuf, *Al-'Ibadah in Islam*, Wahba publication, Etypt, 24th edition, 1995.
9. Alkhuli, Muhammad Ali, *The Light of Islam*, E 4, Riyad: Al Farazdak Press, 1983.
10. Sarwar, Ghulam, *Islam: Beliefs and Teachings*, London: The Muslim Educational Trust, 1980.

## Third Semester

<b>Course Code: PHARM-2301</b>		
<b>Course Title: Basic Pharmaceutics</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To develop a comprehensive understanding of important aspects in dosage form design, choice of excipients and understanding of incompatibilities of drugs.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand basics of pre-formulation and pharmaceutical incompatibilities.
- Know physicochemical properties and uses of excipients.
- Discuss theory of dispersed systems, methods of particle size determination.

### Section-A (Mid-term: 30 Marks)

- 1. Introduction to Pharmaceutics:** Concept of pharmaceutics, pharmacopoeias, formularies; introduction to dosage forms and routes of administration, introduction to GMP.
- 2. Pharmaceutical Excipients/Additives:** Chemistry, physical properties and uses of following excipients: diluents, antimicrobial preservatives, antioxidants, buffering agents, chelating agents, complexing agents, emulsifying agents, acidifying agents, alkalizing agent, air displacement agents, antifoaming agents, sweetening agents, humectant, stiffening agents, desiccants, ointment bases, colors, flavoring agents, binder, disintegrants, glidants, lubricants, coating agents, solvents and co-solvents, wetting and solubilizing agents etc.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Incompatibilities of Drugs:** Therapeutic incompatibilities: pharmacokinetic interactions, pharmacodynamic interactions; Chemical incompatibilities: oxidation, hydrolysis, polymerization, isomerization, decarboxylation etc; Physical incompatibilities: insolubility, immiscibility, liquification/eutexia etc.
- 4. Pre-formulation:** Preliminary evaluation and molecular optimization, bulk characterization of the material, crystal nature and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis,  $p^{ka}$  determination, pH solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability and solid state stability.

#### Group-B (30 Marks)

- 5. Micromeritics:** Importance of particle size determination, different means of expressing particle size, methods of particle size determination, optical and electron microscope studies, coulter counter methods, laser beam technique, sieve analysis, sedimentation methods, particle shape and surface area measurement.
- 6. Properties of Dispersed Systems:** Theoretical aspects of suspension, emulsion, and colloids, surface characteristics and zeta potential, inter-particle force, crystal growth, wetting, adsorption at solid-liquid interface, surface and interfacial tension, flocculation and coalescence, theory of sedimentation, effect of Brownian movement.

#### Recommended Books:

1. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
2. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.

3. S. J Carter (2005), *Cooper and Gunn's Tutorial Pharmacy*, CBS Publishers and Distributors.
4. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
5. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
6. Ansel, H.C and Allen, L.V. (2003) *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*, 10<sup>th</sup> ed. Lippincott Williams and Wilkins.
7. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
8. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
9. Sheskey, P.J, et.al (2017) *Handbook of Pharmaceutical Excipients*, 8<sup>th</sup> ed. Pharmaceutical Press.
10. Dittert, L.W et.al (1975) *Sprowls' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: PHARM-2303</b>		
<b>Course Title: Pharmacognosy and Phytochemistry-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide the biosynthetic pathways and classification of alkaloids, volatile oils, glycosides, resins and tannins as well as their biological activities of several compounds. The subject also includes basic information of poisonous plants.

**Course Outcomes:** At the end of the course, the student will be able to:

- Know sources, constituents and therapeutic uses of different alkaloids, volatile oils, glycosides, resins and tannins.
- Discuss biosynthetic pathways of different phyto compounds.
- Gain knowledge relating to side effects of poisonous plants and natural pesticides.

### **Section-A (Mid-term: 30 Marks)**

1. **Alkaloids:** Biosynthesis of tropane, quinoline, isoquinoline and indole alkaloids. Sources, constituents, uses of the followings-
  - a) Tropane-Belladonna, stramonium, hyoscyamus and lica
  - b) Quinoline-Cinchona, cusparia bark
  - c) Isoquinoline-Ipecacs, opium, sanguinaria, curare
  - d) Indole-Ranwolfia, nux vomica, ergot, catharanthus
  - e) Imidazole: Pilocarpine
  - f) Steroidal: Veretrum viride, aconite
  - g) Lupinea-Lupinus spp
  - h) Purine base: coffee, tea etc.
2. **Resin and Resin Combinations:** Resin, oleoresin, oleo-gum resin, tolu balsam and benzoin.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

3. **Glycosides and glycoside containing drugs:** Biosynthesis of glycosides; Sources, constituents, uses of the followings-
  - a. Cyanogenic: Wild cherry
  - b. Isothiocyanate-mustard (black-mustard and white mustard).
  - c. Cardiac: Digitalis, strophanthus, squill.
  - d. Saponins: Sarsaparilla, glycyrrhiza, dioscorea.
  - e. Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb,
  - f. Other glycosides and neutral principles: Gentian, quassia, saffron.
4. **Phenolic Compounds and Tannins:** Chemical nature and test for tannins some taruin containing drugs such as nutgall and catechu.

### Group-B (30 Marks)

5. **Volatile Oils and Related Terpenoids:** Methods of obtaining volatile oils, chemistry, their medicinal and commercial uses, biosynthesis of some important volatile oils used as drugs. Details of different types of volatile oils-
- Terpenes or sesquiterpenes: Pinus, juniper, cade
  - Alcohols: Coriander, Sandalwood, rose
  - Ester: Peppermint, lavender, rosemary
  - Aldehydes: Cinnamon bark, eucalyptus, lemon peel, lemon grass.
  - Ketones: Spearmint, caraway, dill, camphor
  - Phenols: Clove, cinnamon leaf, Arjowan
  - Ethers: Fennel, nutmeg, eucalyptus, cajuput
  - Peroxides: Chenopodium
  - Others: Mustard, wintergreen, bitter almond
6. **Poisonous Plants and Natural Pesticides:** Datura, poison hemlock, water hemlock, foxglove (digitalis), ipornoca, tobacco, poppy, pyrethrum flower, derris and lanchocarpus, red squill, strychnine, etc.

#### Recommended Books:

- Tyler, V.E, Brady, L.R and Robbers, J.E (1982) *Pharmacognosy*. Lea and Febiger.
- Evans, W.C (2002) *Trease and Evans' Pharmacognosy*. Saunders/Elsevier.
- Wallis, TE (2005) *Textbook of Pharmacognosy*. Churchill Livingstone/Elsevier.
- Zafar, R, Gandhi, N (2007) *Practical Pharmacognosy*. CBS Publishers and Distributors.
- Ikan, R (2013) *Natural Products: A Laboratory Guide*, 2<sup>nd</sup> edition. Academic Press/Elsevier.
- Ghani, A. (2005) *Textbook of Pharmacognosy*. Institute of Medical Technology.
- Ali, M. (1998) *Textbook of Pharmacognosy*, 2<sup>nd</sup> ed. CBS Publishers.
- Raghunathan, S. and Mitra, R. *Pharmacognosy and Indigenous Drugs* (Volumes I, II).
- Ghani, A. (2011) *Medicinal Plants: Chemical Constituents and Uses of Medicinal Plants of Bangladesh*. Lambert.
- Basu, B.D, *Indian Medicinal Plants: Plates*.

<b>Course Code: PHARM-2304</b>		
<b>Course Title: Pharmacognosy and Phytochemistry-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge for compounds extraction and identification techniques from medicinal plants.

**Course Outcomes:** Upon completion of the course, the student will be able to:

- Familiar with the extraction process of medicinal plants.
- Extract alkaloid, volatile oil and tannin from medicinal plants.
- Perform qualitative test for identification of caffeine, tannin, and glycoside.

#### Experiments:

- Study of some medicinal plants in Bangladesh.
- Brief introduction to phytochemical screening and extraction process of medicinal plants.
- Phytochemical screening of supplied medicinal plant extract.
- Extraction of alkaloid (caffeine) from supplied Tea leaves.
- Qualitative test of caffeine from supplied Tea leaves.
- Extraction and qualitative test of alkaloids from supplied Betel nut.
- Extraction and qualitative test of volatile oils from supplied Cinnamon bark.
- Extraction and qualitative test of volatile oils from supplied Clove.
- Extraction and qualitative test of tannins from supplied crude drug (Clove).
- Qualitative analysis of glycoside from supplied plant sample.
- Extraction of alkaloids from supplied Belladonna.

<b>Course Code: PHARM-2305</b>		
<b>Course Title: Biochemistry and Molecular Biology-I</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To understand the cellular and molecular levels of the chemical process associated with living cells that includes cell division and cell cycles, nucleic acid, proteins and to understand the role of enzymes.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand process of cell division, structure of DNA, RNA.
- Explain role of amino acid in protein synthesis, separation techniques of protein.
- Know importance of enzymes and coenzymes in catalytic reactions.

### **Section-A (Mid-term: 30 Marks)**

2. **General Introduction and Historical Background of Molecular Biology:** The Mendelian view of the world, Mendelian law, chromosomal theory of heredity, chromosomal determination of sex, Chromosomal mapping of Annotment (Mendelian second law), preliminary attempts to find a gene protein relationship.
3. **Nuclear Structure and Function:** Cell cycle and cell division, mitosis and meiosis, cell fate, apoptosis; structure and function of chromosomes.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

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

#### **Group-B (30 Marks)**

5. **Proteins:** Important bonds in protein, important functions of protein in biological system, importance of amino acid sequence in protein structure, different amino acids structures and functions, peptide bond, disulfide bridge in protein structure, peptide bond is rigid and planner,  $\alpha$  helix,  $\beta$  sheet, hairpin turn, denaturation and renaturation of protein, proteins are rich in hydrogen-bonding potentiality, different structures of protein, conformational change of protein, gel electrophoresis, 2-D gel electrophoresis, purification of protein, synthesis of protein, protein sequencing, recombinant DNA technology for protein sequencing.
6. **Enzymes:** Chemical nature, classification, catalytic properties, enzyme specificity, mechanism of enzyme actions, enzyme catalyzed reactions, enzyme activation and inhibition, competitive inhibition, allosteric inhibition, irreversible inhibition of poisons and toxins, chemotherapy and enzyme inhibition; Coenzymes: thiamin pyrophosphate, flavin coenzyme, pantothenic acid,  $\text{NAD}^+$ ,  $\text{NADH}^+$ ,  $\text{NADPH}^+$ , pyridoxal pyrophosphate, biotin, vit-B<sub>12</sub>, coenzymes isoenzyme and isoenzyme in clinical use.

#### **Recommended Books:**

1. Nelson, D.L, Cox, M.M (2012) *Lehninger's Principles of Biochemistry*, 6<sup>th</sup> ed. W.H. Freeman
2. Rodwell, V.W, et.al (2015) *Harper's Illustrated Biochemistry*, 30<sup>th</sup> ed. Lange/McGraw-Hill.
3. Elliot, W.H and Elliot, D.C (2009) *Biochemistry and Molecular Biology*, 4<sup>th</sup> ed. Oxford University Press.
4. Satyanarayana, U and Chakrapani, U (2007) *Biochemistry*, 3<sup>rd</sup> ed. Books and Allied.
5. Deb, A. C. (2001) *Fundamentals of Biochemistry*, 9<sup>th</sup> ed. New Central Book.
6. Berg, J.M, Tymoczko, J.L, Stryer, L (2002) *Biochemistry*, 5<sup>th</sup> ed. W.H Freeman.
7. West, E.S, et.al (1966) *Textbook of Biochemistry*, 4<sup>th</sup> ed. Collier-Mac/Macmillan.

8. Champe, P.C, Harvey, R.A, Ferrier, D.R (2007) *Biochemistry*, 4<sup>th</sup> ed (Illustrated Reviews). Lippincott.  
 9. De Robertis, E. (1987) *Cell and Molecular Biology*, 8<sup>th</sup> ed. Lippincott Williams and Wilkins.  
 10. Koolman, J and Roehm, K.H (2012) *Color atlas of Biochemistry*, 3<sup>rd</sup> ed. Thieme.

<b>Course Code: PHARM-2307</b>		
<b>Course Title: Human Physiology-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To understand the structure, functions and control mechanisms of human body systems that include nervous system, endocrine system, reproductive system, excretory system as well as metabolic pathways.

**Course Outcomes:** At the end of the course, the student will be able to:

- Explain physiology and functions of nervous system, endocrine system and associated disorders.
- Understand physiology of reproductive system and functions of different hormones.
- Learn metabolic pathways of fat, carbohydrate, proteins and different vitamins and hormones.

### Section-A (Mid-term: 30 Marks)

- 1. Nervous System:** Properties of nerve cells, neurotransmitter: classification, mechanism of secretion; action potential and its phases, nerve impulses and their transmission, EPSP and IPSP, reflex action, reflex arc, components of reflex arc, principal afferent and efferent paths of CNS, functions of spinal cord and brain, cranial nerve and spinal nerve. Circulation, composition and functions of CSF. The autonomic nervous system, properties of synapses and synaptic transmission.
- 2. Endocrine Glands:** Structure, physiology and functions of hypothalamus, pituitary, thyroid, parathyroid, suprarenal and pancreas. Synthesis, storage and release of different hormones; mechanism of hormonal action; Imbalance in secretion of hormones: Gigantism, Dwarfism, Goiter, Acromegaly, Cushing's syndrome etc.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Reproductive System:** Male reproductive system: Testis and the accessory of organs. Male sex hormone, formation of spermatozoa and its control by various hormones, Female reproductive system: Ovaries, Uterus, Oviduct etc, menstrual cycle and its control, diagnosis of pregnancy; Female sex hormones: Estrogens and progesterone; pregnancy and lactation and their hormonal control, pregnancy test.

#### Group-B (30 Marks)

- 4. Metabolism:** Fat, carbohydrate, protein and nucleoprotein metabolism. Metabolic pathways of fat, carbohydrate and proteins, enzymes, vitamins and hormones regulating various metabolic steps; vitamin and minerals: physiological properties and functions.
- 5. Excretory System:** Structure and functions 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.

#### Recommended Books:

1. Guyton, A.C and Hall, J.E (2005) *Textbook of Medical Physiology*, 11<sup>th</sup> ed. Saunders/Elsevier.
2. Chatterjee, C.C (2016) *Human Physiology* (Volumes I and II), Revised 11<sup>th</sup> ed. CBS Publishers.
3. Barrett, K.E, et.al (2005) *Ganong's Review of Medical Physiology*, 22<sup>th</sup> ed. Lange/McGraw-Hill.
4. Ghai, C.L (2012) *A Text Book of Practical Physiology*, 8<sup>th</sup> ed. Jaypee Brothers.
5. Standring, S. (2008) *Gray's Anatomy*, 40<sup>th</sup> ed (International student's edition). Churchill Livingstone.

6. Costanzo, L.S (2014) *Physiology* 6<sup>th</sup> ed (Board Review Series). Lippincott Williams and Wilkins.
7. Keele, C.A, Neil, E, Joels, N (1992) *Samson Wright's Applied Physiology*, 13<sup>th</sup> ed. Oxford University Press.
8. Ahmed, K.M. *Physiology of Blood*, 2<sup>nd</sup> ed. Hafiz Books.

<b>Course Code: PHARM-2308</b>		
<b>Course Title: Human Physiology-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical experience for estimation of various physiological parameters.

**Course Outcomes:** By the end of the course, the student will be able to:

- Measure blood pressure, respiration and hearing condition.
- Estimate blood sugar, cholesterol, protein and creatinine levels.

**Experiments:**

1. Recording of respiration with stethograph.
2. Measurement of B.P. with sphygmomanometer.
3. Measurement of hearing condition by using tuning fork.
4. RBC fragility test.
5. Biochemical test on saliva: effect of ptyalin on starch.
6. Estimation of blood sugar in normal person.
7. Estimation of plasma cholesterol level.
8. Estimation of plasma protein level.
9. Estimation of plasma creatinine level.

<b>Course Code: PHARM-2309</b>		
<b>Course Title: Pharmaceutical Microbiology and Immunology-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To acquire knowledge on the scope, classification, historical developments, importance and application of microbiology in pharmaceutical sciences and environment; microscopic examination of microorganisms, morphology of bacteria as well as their culture; and basic concept of immunology.

**Course Outcomes:** Upon completion of the course, the student will be able to:

- Handle various types of microscopic techniques and examination process of microorganisms.
- Differentiate various types of bacteria on the basis of morphology by various staining techniques, bacterial growth and cultivation.
- Understand the basic concept of immunology, infections, vaccines and sera.

**Section-A (Mid-term: 30 Marks)**

1. **The Scope of Microbiology:** Definition, major fields, scopes of microbiology. Prokaryotic and Eucaryotic cells. The place of microorganisms in nature- Protist, Major groups of microorganism, distribution of microorganisms in nature, usefulness and harmfulness of microorganisms in pharmacy.
2. **The History of Microbiology and Characterization of Microorganisms:** Important terms- spontaneous generation, biogenesis, fermentation, Germs theory of diseases etc; discovery of causative agents of microbial diseases, pioneers of microbiology, major characteristics of microorganisms.

- 3. The Microscopic Examination of Microorganisms:** Microscope-definition and types and their principles, applications etc. important terms like Magnification, resolving power, Resolution, Refractive index, Numerical aperture, Aperture angle etc; Preparation for Light microscope Examinations., Microbiological stains, Staining procedures. Differential Staining- Gram Staining-procedure and explanations. Difference between Gram positive and Gram negative bacteria.

**Section-B (Final Exam: 50 Marks)**

**Group-A (20 Marks)**

**4. Bacteria:**

- a) **The Morphology and Fine Structure of Bacteria:** The size, shape and arrangement of bacterial cells, bacterial structures.
- b) **The Cultivation of Bacteria:** Nutritional requirements, nutritional types of bacteria, Bacteriological Media-Definition, types, Physical Conditions required for growth.

**Group-B (30 Marks)**

- c) **Reproduction and Growth of Bacteria:** Reproduction, Growth, Normal growth cycle, quantitative measurement of bacterial growth.
- d) **Pure Culture and Cultural Characteristics:** Pure cultures-definition and methods of isolating pure cultures, Maintenance and preservation of pure cultures.
- 5. Immunology:** Basic concept of immunology, infections, immunity, pathogenicity and virulence, factors influencing infections; vaccine- types and production.

**Recommended Books:**

1. Pelczar M.J, Kreig, N.R and Chan, E.C.S. (1985) *Microbiology*, 5<sup>th</sup> ed. McGraw-Hill.
2. Denye, S.P, et.al (2004) *Hugo and Russell's Pharmaceutical Microbiology*, 7<sup>th</sup> ed. Blackwell.
3. Reed, G. (2004) *Prescott and Dunn's Industrial Microbiology*, 4<sup>th</sup> ed. CBS Publishers.
4. Purohit, S.S, et.al (2008) *Pharmaceutical Microbiology*, Student Edition. Agrobios.
5. Jain, N.K (2005) *Pharmaceutical Microbiology*, 2<sup>nd</sup> ed. Vallabh Prakashan.
6. Harris, M. (1965) *Pharmaceutical Microbiology*. Bailliere, Tindall and Cox.
7. Choudhury, M.R (1999) *Modern Medical Microbiology*. Bishwa Parichaya.
8. Stanier, R.Y (1999) *General Microbiology*, 5<sup>th</sup> ed. Macmillan.
9. Tortara G.J, et.al (2016) *Microbiology: An Introduction*, 12<sup>th</sup> ed. Pearson.
10. Madigan, M.T, Martinko, J.M, et.al (2014) *Brock Biology of Microorganisms*, 14<sup>th</sup> ed. Pearson.
11. Salle, A.J, (2007) *Fundamental Principles of Bacteriology*. Envins Press.

<b>Course Code: PHARM-2310</b>		
<b>Course Title: Pharmaceutical Microbiology and Immunology Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical experience on microscopic method, preparation of bacterial culture, examination of different microorganisms and their identification as well as quantitative measurement.

**Course Outcomes:** By the end of the course, the student will be able to:

- Identify bacteria, fungi, yeast and mold using microscope.
- Prepare culture and sterile bacterial media.
- Identify bacteria and quantitative measurement of microorganisms.

**Experiments:**

1. Preparatory lab class: Introduction, ethics, rules, precautions etc of microbiology classes.
2. Study of microscope, incubator, hot air oven, autoclave etc.
3. Microscopic observation of bacteria.

4. Microscopic observation of fungi, yeast and mould etc.
5. Study of Laminar air flow bench.
6. Preparation and sterilization of bacterial media.
7. Isolation of pure culture by streak plate technique
8. Identification of bacteria by Gram staining technique
9. Quantitative measurement of microorganisms by direct microscopic method
10. Quantitative measurement of microorganisms by Pour Plate technique
11. Disc diffusion method of antimicrobial screening of supplied sample against pathogenic bacteria.

<b>Course Code: STAT-2301</b>		
<b>Course Title: Biostatistics</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To cover key statistical concepts used in life science research, such as study design methods, sampling, population considerations, and hypothesis test. The course will provide an introduction to widely used statistical methods, and interpretation of data outputs.

**Course Outcomes:** After completion of the course, the student will be able to:

- Know various statistical methods to solve different types of problems.
- Appreciate statistical techniques in solving the pharmaceutical problems.

### **Section-A (Mid-term: 30 Marks)**

**1. Preliminaries:** Definition of Statistics, Its necessity and importance, Population and Sample, Variable and Constants, Different types of variables, Statistical data, Data Collection and presentation, Construction of Frequency distribution, Graphical presentation of Frequency distribution, Different sampling methods.

**2. Measures of Central Tendency:** Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode, Weighted Mean, and Theorems and Problems.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

**3. Fundamentals of Probability:** Elementary Concepts, Laws of Probability - Additive and Multiplicative Law, Conditional Probability and Bay's theorem.

**4. Probability:** Random Variables, Mathematical Expectation and Variance of a random variable, theorems and problems.

**5. Probability Distributions:** Binomial distribution, Poisson distribution and Normal distribution- properties, uses, theorems and problems.

#### **Group-B (30 Marks)**

**6. Correlation Theory:** Linear Correlation- measures and significance; Rank Correlation, Theorems and Problems.

**7. Regression Analysis:** Linear and non-linear regression, Least-square method of curve fittings, Theorems and Problems.

**8. Measures of Dispersion:** Range, Standard Deviation, Mean Deviation, Quartile Deviation, Variance, Moments, Skewness and Kurtosis, Theorems and Problems.

#### **Recommended Books:**

1. Armitage, P, Berry, G, Matthews, J.N.S (2001) *Statistical Methods in Medical Research*, 4<sup>th</sup> ed. Wiley-Blackwell.
2. Bland, M. (2015) *An Introduction to Medical Statistics*, 4<sup>th</sup> ed. Oxford University Press.
3. Gupta, S.P (2006) *Statistical Methods*. Sultan Chand and Sons.

4. Hannan, J.M.A (2007) *A textbook of Medical and Pharmaceutical Statistics*, 2<sup>nd</sup> ed. Sangbed Publishers.
5. Mostafa, M.G (1989) *Methods of Statistics*, 4<sup>th</sup> ed. Karim Press and Publications.
6. Spiegel, M.R and Stephens, L.J (2014) *Schaum's Outline of Statistic*, 5<sup>th</sup> ed. McGraw-Hill.
7. Gupta, S.P and Gupta, M.P (2010) *Business Statistics*. Himalaya Publishing.

<b>Course Code: STAT-2302</b>		
<b>Course Title: Biostatistics Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge incorporates the statistical data interpolation and extrapolation.

**Course Outcomes:** At the end of the course, the student will be able to:

- Know data input and interpretation.
- Construct and represent different types of graphs.
- Operate various statistical software packages.

**Experiments:**

1. Introduction with basic functions of Microsoft Office Excel such as data input, arrangement, copy, cut, paste, cell editing, word file input, printing etc.
2. Determination of sum, average, maximum and minimum value, number count etc in Microsoft Office Excel.
3. Determination of regression value from line chart.
4. Interpolation and extrapolation of data from diagram.
5. Construction and presentation of data in the line chart.
6. Construction and presentation of data in the pie chart.
7. Construction and presentation of data in the column chart.
8. Construction and presentation of data in the bar diagram.
9. Calculation of standard deviation and standard error mean.
10. Input of group data and presentation of error bar in the diagram.
11. Calculation of IC<sub>50</sub> value from regression analysis.
12. Presentation of data and related information in the tabulation sheet.

<b>Course Code: URED-2302</b>		
<b>Course Title: Sciences of <i>Qur'an</i> and <i>Hadith</i></b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:**

- To make the students familiar with the basic sciences of Qur'an and Hadith to understand them properly.
- To provide them with proper knowledge to establish their authenticity and remove misconceptions concerning them.
- To achieve the main goal of the University in Islamization of Knowledge through enlightening the students with revealed knowledge of the Qur'an and Hadith.

**Course Outcomes:**

- After completion of this course:
- The students will have knowledge of the status of Qur'anic verses and Hadiathic text.
- They will be able to establish the authenticity of Qur'an and Sunnah.
- To have inspiration to achieve knowledge from the Qur'an and Sunnah directly.

### Section-A (Midterm Exam: 30 Marks)

1. **Sciences of Qur'an:** (1) Definition of the Qur'an Literally and Terminologically (2) Various Names and Attributes of the Holy Qur'an and their Significance (3) Characteristics of the Holy Qur'an (4) Central Subject Matter and the Main Themes of the Holy Qur'an (5) The necessity of the Holy Qur'an (6) The authenticity of the Holy Qur'an.
2. **Wahi (Revelation) of the Holy Qur'an:** (1) Meaning of *Wahi* (2) Various classifications and procedure of *Wahi* (3) Stages of revelation of the Holy Qur'an (4) Gradual revelation of the Holy Qur'an and the wisdom behind it (5) The First and the Last Revelation.
3. **The Ayah and Surah of the Holy Qur'an:** (1) The *Ayah* of the Qur'an: Definition of *Ayah*. The Number of *Ayah*, words and letters of the Holy Qur'an. The Arrangement of the *Ayah* of the Holy Qur'an (2) The *Surah* of The Qur'an: Definition of *Surah*. The Arrangement of *Surah* of the Holy Qur'an. The classification of *Surah* of the Holy Qur'an.

### Section-B (Final Exam: 50 Marks)

4. **Makki and Madani Revelations:** (1) The Definition of *Makki* and *Madani* (2) The Characteristics of *Makki* and *Madani* Revelations (3) The benefits of knowing *Makki* and *Madani* Revelations.
5. **Preservation, Compilation and Asbabunnuzul (revelational background):** (1) Preservation and Compilation of the Holy Qur'an (2) The Causes of Revelation (*Asbabunnuzul*): The Definition of *Asbabunnuzul*. The classification of *Asbabunnuzul*. The benefits of Knowing *Asbabunnuzul*.
6. **Al-Naskh (Abrogation) and I'jaz (inimitability) of The Qur'an:**
  - (1) **Abrogation (Al-Naskh) in the Holy Qur'an:** Definition of *Naskh*. The proofs of *Naskh*. The Classifications of *Naskh*. The benefits of knowing *Nasikh* (abrogating) and *Mansukh* (abrogated) verses.
  - (2) **The Miraculous Nature of The Qur'an (I'jaz Al-Qur'an):** Definition of *I'jaz*. The Proofs of *I'jaz*. Various aspects of *I'jaz Al-Qur'an*.
7. **Sciences of Hadith:** (1) Definition of *Sunnah* (2) Difference among Qur'an *Sunnah* and *Hadith Qudshi* (3) The Position, importance and authority of *Sunnah* in Islamic *Shari'ah* (4) Explanation of some important terms of *Sunnah*: *Isnad/ Sanad*, *Matn*, *Rawee* and *Riwayah*, *Al-jame'*, *Al-Musnad*, *Al-Sahih*, *Al-Sunan*, *Sahihayn*, *Muttafaqun 'Alayh*, *Al-kutub As-Sittah*...etc. (5) Collection and Compilation of *Sunnah*.
8. **The classification of Hadith and fabrication in Hadith:**
  - (1) **The classification of Hadith:** (a) According to the reference to a particular authority (b) According to the links in the *Isnad* (c) According to the number of narrators involved in each stage of the *Isnad* (d) According to the reliability and memory of the narrator.
  - (2) **Fabrication in Hadith:** (a) Definition of Fabrication (b) Causes and consequence of fabrication (c) Some examples of commonly used fabricated *Hadith* in our society.

#### Recommended Books:

##### Sciences of Qur'an:

1. Denffer, Ahmad, vol. '*Ulum Al-Qur'an: An Introduction to the Sciences of the Qur'an*, The Islamic Foundation, UK, reprinted by – A.S. Noordeen, Kuala Lumpur. 1983.
2. Ushama, Dr. Thameem, *Sciences of the Qur'an: An Analytical Study*, International Islamic University Malaysia, Cooperative Limited, Kuala Lumpur. 1998.
3. Bucaille, Dr. Maurice, *The Bible The Qur'an and Science*, Thinkers Library, Selangor Darul Ehsan. Malaysia, 1996.
4. Badruddin Muhammad bin Abdullah Al-Badruddin Al-Zarkashi, *Al-Burhan Fi Ulumil Qur'an*, Dar Al-Marifah, Bairuth, VI. 01.

5. A Study of the Holy Qur'an and its Teachings, First edition, IQRA International Education Foundation, Chicago, April-1999.

**Sciences of Hadith:**

1. Al-Azami, Dr Mohammad Mustafa, *Studies in Early Hadith Literature*, American Trust publication, Indiana, 1978.
2. Hasan, Dr. Suhaib, *An Introduction to the Science of Hadith*, London, AL-Qur'an Society, 1994.
3. Marhribi, Al-Hassan, *Introduction to the Study of the Hadith*, Roshmee, South Africa, Roshmee Islamic School, 1994.
4. Salih, Muhammad Adeeb, *Lamahat fee Usul al-Hadeth*, Damascus, 1393 AH. Siddiqi, Muhammad Zubayr, *Hadith Literature: its Origin, Development and Special Features*, Cambridge, Islamic Texts Society, 1993.
5. Siddiqi, Muhammad Zubayr, *Hadith Literature: its Origin, Development and Special Features*, Cambridge, Islamic Texts Society, 1993.

<b>Course Code: URED-2305</b>		
<b>Course Title: Comparative Religion</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** This course is designed to engage the students in the different types of religions and increase their knowledge. This course will feature the Muslim, Christian, Hindu, Buddhist and Jewish religious origins, customs and traditions, and some basic principles. These topics will require solutions and teamwork. Every student will be partnered up with another student for the duration of the course.

**Course Outcomes:** After completion of this course:

- Students will demonstrate understanding of the central beliefs and concepts of major living religious traditions of the world, including Hinduism, Buddhism, Judaism, Christianity, and Islam.
- Students will demonstrate familiarity with the structure and ritual life of religious communities, including significant holidays and rituals.
- Students will demonstrate a grasp of the methodology of the study of religion.
- Students will develop skills in critically analyzing religion and comparing particular aspects of religious traditions.
- Students will develop skills in reading source texts as documents of religious life.
- Students will develop skills in observing and critically analyzing religion in the contemporary world.
- Students will be aware of how to decrease Islam phobia among the non-Muslim community and increase mutual relationship among them.

**Section-A (Midterm Exam: 30 Marks)**

**1. Concept of religion:**

- a) Definition of religion.
- b) Significance, necessity and characteristics of religion.
- c) Approaches to the study of religions (Historical, Anthropological, Sociological, Philosophical and Phenomenological etc.).

**2. Origin and Development of Major Religions:**

- a) Basic history of major religions (Judaism, Christianity, Hinduism, Buddhism and Islam).
- b) Founders and profounder of religions.

**3. The Features of Major Religions and Holy books and Sacred Texts:**

- a) The distinguishing features of major religions (Judaism, Christianity, Hinduism, Buddhism and Islam).
- b) Holy books and sacred texts of major religions.

**Section-B (Final Exam: 50 Marks)****4. Religious rituals, festivals and Holy places:**

- a) Rituals of major religions.
- b) Festivals of major religions.
- c) Holy places of major religions.

**5. The Comparative study of God in major religions:**

- a) Concept of God in Judaism.
- b) Concept of God in Christianity.
- c) Concept of God in Hinduism.
- d) Concept of God in Buddhism.
- e) Concept God in Islam.

**6. The Comparative study of religious mentors and prophets in major religions:**

- a) Necessity of Prophets and Spiritual guides for human life.
- b) Comparative study of prophecy and religious mentorship in famous religions.

**7. The Comparative Study of Life after Death in major religions:**

- a) Concept of Death in different religions.
- b) Concept of Day of Judgment in different religions.
- c) Concept of Heaven and Hell in different religions.

**8. The understanding of Man and Universe in major religions.**

- a) The purpose of Human being.
- b) The purpose Universe.

**9. The common values in major religions:**

- a) Ethics and Morality
- b) Evil.
- c) Justice.
- d) Destiny and Luck.
- e) Religious diversity.
- f) Non-violence and Peaceful co-existence
- g) Harmony and Interfaith dialogue.
- h) Social Justice and Human Ideological rights.

**Recommended Books:**

1. Sharpe, E. J. (1989). *Comparative religion: A history*.
2. Eliade, M. (1996). *Patterns in comparative religion*. U of Nebraska Press.
3. Eastman, Roger (1999) *The Ways of Religion: An Introduction to the Major Traditions*. Oxford University Press, US; 3 edition.

## Fourth Semester

<b>Course Code: PHARM-2401</b>		
<b>Course Title: Pharmaceutical Technology-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide a comprehensive understanding of pharmaceutical processing, manufacturing technologies, quality control of powder, liquid, semisolid, blood products, emulsion and suspension.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand basics of formulation and production process of powder, liquid, semisolid, blood products, emulsion and suspension.
- Describe evaluation and quality control process of different dosage forms.
- Know production problems associated with manufacturing of dosage forms and their remedies.

### Section-A (Mid-term: 30 Marks)

1. **Powders and Granules:** Definition, advantages, pharmaceutical importance, Official classifications, methods of preparation; Blending powders; Medicated powders: aerosol powders, bulk powders, divided powders, powder for suspension (PFS), powder for injection (PFI); snuffs, dentifrices etc. Advantages and preparation of granules, effervescent granules.
2. **Liquid dosage forms:** Definition, advantages, disadvantages, different types of liquid dosage forms, theory of solution, different factors affecting solution process, formulation consideration, manufacturing considerations, packaging, preservation and stability aspects, and quality control systems of liquids.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

3. **Semisolids (Ointments, Pastes, Gels):**
  - (a) **Physiology of Skin:** Structure of skin, percutaneous absorption of drugs, study of skin penetration (in vitro and in vivo techniques), factors in skin penetration.
  - (b) **Ointments:** Definition and classification of semisolids, classification of ointment bases, advantages and disadvantages, formulation of ointments, manufacturing of ointments, rheological considerations, evaluation and quality analysis of ointment, ophthalmic ointments.
  - (c) **Paste and Gels:** Properties, advantages and disadvantages, formulations and preparations.
4. **Blood and Related Products:** Whole human blood, anticoagulants, dried human plasma, concentrated human corpuscles, dried human plasma, dried human serum, dried plasma and serum, human plasma protein fraction, human fibrinogen, human thrombin, human normal immunoglobulin injection, quality control of blood products.

#### Group-B (30 Marks)

### 5. Dispersed Systems:

- (a) **Suspensions:** Definitions and applications, advantages and disadvantages, dispersed systems, classifications, theory of sedimentation, formulation of suspensions, manufacturing of suspension, stability of suspension, evaluation and quality analysis of suspension, rheological considerations and illustrative examples.

**(b) Emulsions:** Definitions and applications, advantages and disadvantages, theory of emulsion, formation of emulsion, classification of emulsifying agents, HLB values of surface active agents; formulation, manufacturing, stability and identification of emulsion types, evaluation and quality analysis, rheological considerations, illustrative examples.

**Recommended Books:**

1. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
2. Ansel, H.C and Allen, L.V. (2003) *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*, 10<sup>th</sup> ed. Lippincott Williams and Wilkins.
3. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
4. Carter, S. J (2005), *Cooper and Gunn's Tutorial Pharmacy*, CBS Publishers and Distributors.
5. Gupta, A.K (2004), *Introduction to Pharmaceutics*, Vol. I and II, 3<sup>rd</sup> ed. CBS Publishers.
6. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
7. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
8. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
9. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
10. Sheskey, P.J, et.al (2017) *Handbook of Pharmaceutical Excipients*, 8<sup>th</sup> ed. Pharmaceutical Press.
11. Dittert, L.W et.al (1975) *Sprrows' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: PHARM-2402</b>		
<b>Course Title: Pharmaceutical Technology-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical experience in several pharmaceutical aspects particularly the manufacture of various dosage forms.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain production experience on dosage forms like solution, suspension, syrup, elixir, emulsion, suspension, lotion, ointments, gel.
- Demonstrate evaluation process of dosage forms.
- Know condition of storage, labeling system.

**Experiments:**

1. Preparation of percent solution and calculation
2. Preparation of aromatic water
3. Preparation of syrup
  - a) Phenobarbital-Na syrup
  - b) Chlorpheniramine maleate syrup
  - c) Iron syrup
4. Preparation of suspension
  - a) Paracetamol suspension
  - b) Antacid suspension
5. Preparation of Phenobarbital elixir
6. Preparation of emulsion and identification of type of emulsion
  - a) Primary emulsion by dry gum method and wet gum method
  - b) Castor oil emulsion
7. Preparation of lotion.
8. Preparation of ointment, gel and paste.
9. Measurements of bulk density, true density, bulk volume, true volume, porosity, voids and bulkiness of different powders.

<b>Course Code: PHARM-2403</b>		
<b>Course Title: Biochemistry and Molecular Biology-II</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To provides an overview of molecular biology today, the knowledge it produces and the technology used in biomedical study. To keep up to date with the advances in the biomedical field we need to understand the molecular mechanisms responsible for genome expression and be familiar with the various pathologies.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Explain fundamental concepts of Molecular Biology.
- Understand cellular and molecular processes that occur inside and between the cells.
- Gain insight of the molecular and cell based methods used in the understanding of biology.

### **Section-A (Mid-term: 30 Marks)**

#### **1. Central Dogma of Molecular Biology:**

- a) Replication:** DNA replication, DNA polymerases, types of DNA replication, DNA damage and repair, inhibitors of replication.
- b) Transcription:** RNA synthesis and mRNA processing, post-transnational modification of mRNA, RNA splicing, promoter, enhancer and transcription factor, inhibitors of transcription.
- c) Genetic Code:** Characteristic feature of genetic code, Wobble hypothesis with experimental evidence, initiation and termination codon.
- d) Translation:** Structure of Ribosome, mechanism of translation, protein synthesis, post-transnational modification, inhibitors of translation.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 2. Regulation of Gene Expression:** Gene expression, general aspect of gene regulation, gene expression regulation in prokaryotic and eukaryotic cell, the operon concept. Synthetic biology: manipulation of gene expression.
- 3. Nucleases:** Restriction enzymes: sources, specificity, digestion of DNA; Exonucleases and endonucleases; RNases, DNases.

#### **Group-B (30 Marks)**

- 4. Mutation:** Types of mutation, molecular mechanism of mutation, site specific mutagenesis, mutation hot spot, DNA repair mechanism, inheriting mutation diseases.
- 5. Techniques in Molecular Biology:** Cloning techniques, polymerase chain reaction (PCR), RT-PCR, reverse transcriptase; DNA sequencing techniques; Southern-, Northern-, and Western blotting, gel electrophoresis, SDS-PAGE.
- 6. Recent Trends in Molecular Biology:** Targeted genome editing: ZFN, TALEN, CRISPR; Gene targeting: knock-in and knock-out, DNA finger printing.

#### **Recommended Books:**

1. Watson, J.D, et.al (2014) *Molecular Biology of the Gene*, 7<sup>th</sup> ed. Pearson/ CSHLP.
2. Krebs, J.E, Goldstein, E.S, Kilpatric, S.T (2017) *Lewin's Genes XII* (12<sup>th</sup> ed). Jones and Bartlett.
3. Lodish, H, et.al (2008) *Molecular Cell Biology*, 6<sup>th</sup> ed. W.H Freeman.
4. Alberts, B, et.al (2014) *Molecular Biology of the Cell*, 6<sup>th</sup> ed. Garland Science/Taylor and Francis.
5. Clark, D.P and Russell, L.D (2010) *Molecular Biology Made Simple and Fun*, 4<sup>th</sup> ed. Cache River.
6. De Robertis, E. (1987) *Cell and Molecular Biology*, 8<sup>th</sup> ed. Lippincott Williams and Wilkins.
7. Passarge, E. (2012) *Color atlas of Genetics*, 4<sup>th</sup> ed. Thieme.

8. Elliot, W.H and Elliot, D.C (2009) *Biochemistry and Molecular Biology*, 4<sup>th</sup> ed. Oxford University Press.  
 9. Champe, P.C, et.al (2007) *Biochemistry*, 4<sup>th</sup> ed (Lippincott's Illustrated Reviews). Lippincott.

<b>Course Code: PHARM-2404</b>		
<b>Course Title: Biochemistry and Molecular Biology Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To acquire practical knowledge for principal techniques used in molecular biology and their applications in pharmacy.

**Course Outcomes:** By the end of the course, the student will be able to:

- Estimate protein concentration and determine molecular weight of protein.
- Measure lipid profiles, serum creatinine level, blood urea level, SGPT, SGOT.
- Synthesize DNA and analyze in silico gene regulation expression.

**Experiments:**

1. Estimation of protein concentration from the supplied sample by Lowry method.
2. Determination of protein content by Spectrophotometric method
3. Determination of extinction coefficient of protein.
4. Identification and molecular weight determination of protein by SDS-PAGE.
5. Identification of DNA by agarose gel electrophoresis.
6. Synthesis of DNA by PCR method.
7. Determination of lipid profiles.
8. Determination of serum creatinine level.
9. Determination of blood urea level.
10. Determination of SGPT, SGOT levels in blood.
11. In silico analysis of gene regulation expression (NCBI Primer-BLAST, SnapGene, Genome Compiler, ApE, MEGA).

<b>Course Code: PHARM-2405</b>		
<b>Course Title: Pharmacology-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To impart basic knowledge on ADME, side effect, adverse effect and toxicity of drugs, sign and symptoms of diseases, mechanism of drug action, dosage information, drug interaction, pharmacology of autacoids and some classes of drugs.

**Course Outcomes:** At the end of the course, the student will be able to:

- Know about drug action and mechanisms involved.
- Describe pharmacological actions of different categories of drugs.
- Understand prevention and treatment strategies of pain and inflammation, peptic ulcers, diarrhea, constipation and blood disorders.

**Section-A (Mid-term: 30 Marks)**

1. **General Pharmacology:** Concept of pharmacology, drug, medicine, pro-drug; pharmacokinetics: absorption, distribution, bioavailability, protein binding, metabolism and excretion; pharmacodynamics, MEC, MTC, therapeutic window, first pass effect, synergism, side effect, adverse effects, toxicity; sign, symptom and syndrome; drug interaction, drug tolerance, drug dependence, drug abuse/misuse, idiosyncrasy, dose, dosage form; pregnancy category of drugs.
2. **Basic Concept of Drug Action:** Basic concept of drug action, drug receptors, receptor and non receptor mechanisms of drugs, macromolecular nature of drug receptors, drug

antagonism, relation between drug dose versus response; agonists, antagonists, competitive and irreversible antagonism, partial agonists.

3. **Autacoids:** Amine (Histamine and 5-Hydroxytryptamine), lipid and peptide autacoids (prostaglandins, bradykinin).
  - a) **Histamines:** Synthesis, mode of action, pharmacological actions, anaphylactic shock; histamine-releasing drugs.
  - b) **Serotonin (5-Hydroxytryptamine):** Occurrence, synthesis, pharmacological actions.
  - c) **Prostaglandins, prostacyclins and thromboxane:** Occurrence, synthesis, pharmacological actions.
  - d) **The kinins:** Kallidins and bradykinin.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

4. **Antihistamines/H<sub>1</sub>-Receptor Blockers:** Allergic disorders; classifications, mechanism of action, pharmacological actions, indications, side effects, dosage of antihistamines etc.
5. **Analgesic, Antipyretic and Antinflammatory Drugs:** Definition of inflammation, pain, fever, nociception, nociceptors and opioid receptors; classifications of pain, mechanism of pain (peripheral and central). Nonsteroidal anti-inflammatory drugs (NSAIDs): salicylates, acetic acid derivatives, propionic acid derivatives, enolic acid (oxicam) derivatives, anthranilic acid derivatives (fenamates), COX-2 selective inhibitors; Narcotic analgesics: opium alkaloids, morphine antagonists, synthetic and semi-synthetic opiates; Other analgesics: Acetaminophen (paracetamol). Pathophysiology of gout; treatment of gout: colchicine, allopurinol, uricosuric agents etc. Antirheumatic agents: methotrexate, leflunomide, d-penicillamine, gold salts etc.

#### Group-B (30 Marks)

6. **Drugs for Peptic Ulcer:** Regulation of gastric acid secretion, factors affecting gastric acid secretion, rebound acidity; Classifications, mechanism of actions, pharmacological actions, indications, side effects, dosage of Antacid, H<sub>2</sub>-receptor blockers, Proton Pump Inhibitor (PPI), Prostaglandin (PG) Analogues, Mucosal-protective agents, Anti *Helicobacter pylori* agents.
7. **Antidiarrheal Agents and Laxatives:** Classifications and causes of diarrhea, management of diarrhea, causes and management of constipation; Antimotility agents, adsorbents, electrolytes, stool softeners, bulking agents.
8. **Haematinic Drugs:** Iron, vitamin B<sub>12</sub>, folic acid, erythropoietin etc.

#### Recommended Books:

1. Rang, H.P, Dale, M.M, et.al (2015) *Rang and Dale's Pharmacology*, 8<sup>th</sup> ed. Churchill Livingstone.
2. Katzung, B.G, et.al (2009) *Basic and Clinical Pharmacology*, 11<sup>th</sup> ed. Lange/McGraw-Hill.
3. Brunton, L.L, et.al (2006) *Goodman and Gillman's Pharmacological Basis of Therapeutics*, 11<sup>th</sup> ed. McGraw-Hill.
4. Satosker, R.S, et.al (2005) *Pharmacology and Pharmacotherapeutics*, 19<sup>th</sup> ed. Popular/ Elsevier India.
5. Finkel, R, et.al (2009) *Pharmacology*, 4<sup>th</sup> ed (Lippincott's Illustrated Reviews). Lippincott/LWW.
6. Tripathi, K.D (2013) *Essentials of Medical Pharmacology*, 7<sup>th</sup> ed. Jaypee Brothers.
7. Bennett, P.N and Brown M.J (2003) *Clinical Pharmacology*, 9<sup>th</sup> ed. Churchill Livingstone.
8. Misbahuddin, M and Islam, M.R (1998) *General Principle of Pharmacology*, 4<sup>th</sup> ed. Books and Allied.
9. Bhattacharya, S.K, Sen, P, Ray, A. (2012) *Pharmacology*, 2<sup>nd</sup> ed. Elsevier India.
10. Khan, A.R. *Essentials of Medical Pharmacology*.
11. Herfindal, E.T and Hirschman, J.L (1992) *Clinical Pharmacy and Therapeutics*, 4<sup>th</sup> ed. Williams and Wilkins.
12. Luellman, H, Mohr, K, Hein, L (2017) *Color Atlas of Pharmacology*, 5<sup>th</sup> ed. Thieme.

<b>Course Code: PHARM-2406</b>		
<b>Course Title: Pharmacology-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To investigate various pharmacological actions of pharmaceutical drugs and familiar with different techniques.

**Course Outcomes:** By the end of the course, the student will be able to:

- Know handling and dose administration process on mice/rats.
- Investigate different pharmacological activities of drugs on mice/rats.

**Experiments:**

1. Introduction to pharmacology lab and instruments.
2. Handling of experimental animals: mice and rats.
3. Investigation of analgesic activity by writhing test on mice/rats.
4. Investigation of analgesic activity by formalin test on mice/rats.
5. Laxative effects of drugs on mice/rats.
6. Antidiarrheal effects of drugs on mice/rats.
7. Study of effect of local anesthetic on mice tail.
8. Effects of histamine and antihistamine on guinea pig.
9. Effect of pilocarpine on saliva secretion on rat.

<b>Course Code: PHARM-2407</b>		
<b>Course Title: Pharmaceutical Microbiology and Immunology-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To acquire knowledge on the scope of industrial microbiology; morphology of virus, streptomyces, rickettsia, fungi and yeast and their industrial uses; sterilization techniques and immune response of human body.

**Course Outcomes:** By the end of the course, the student will be able to:

- Know morphology of microorganisms and appropriate sterilization methods.
- Produce the antibiotics and related substances from microorganisms.
- Understand process of immune response and associated diseases.

**Section-A (Mid-term: 30 Marks)**

1. **Viruses:** History of viruses, classification, characteristics, reproduction and culture of viruses, virus inhibition, control of virus infections, bacterial virus or bacteriophages, morphology and composition, cultivation of bacterial viruses, reproduction of bacterial viruses, Pharmaceutical importance of viruses.
2. **Streptomyces:** Taxonomy, morphology, genomics, biotechnology, plant pathogenic bacteria; Medicine: antifungals, antibacterials, antiparasitic drugs and others.
3. **Industrial Microbiology:** Microorganisms and Industry, prerequisites to practical industrial microbiological processes, Major classes of products and processes, Industrial uses of bacteria, fungi, Bioreactors or Fermenter, production of antibiotics.

**Section-B (Final Exam: 50 Marks)**

**Group-A (20 Marks)**

4. **Rickettsiae:** Introduction, characteristics, classifications, rickettsial ses, therapy and prophylaxis of rickettsial diseases, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases.

5. **Fungi and Yeasts:** Types, morphology, taxonomical classifications of fungi, reproduction, pathogenic yeasts; pharmaceutical importance of fungi and yeasts.

**Group-B (30 Marks)**

6. **Sterilization Procedures and Sterility Assurance:** Introduction, sensitivity of the microorganisms, sterilization methods: Heat sterilization, gas sterilization, Filtration sterilization, new sterilization technologies, sterilization control and sterility assurance, indicators used for monitoring sterilization process, sterility testing.
7. **Immunology:**
- a) **Introduction to immune response:** Innate and acquired immunity, complement, self and non-self discrimination and source and chemistry of antigen.
  - b) **Cells involved in immune system:** Macrophage and other antigen presenting cells, T cells, B cells etc.
  - c) **Antibody:** Classification, chemistry and function.
  - d) **Hypersensitivity:** Immediate and delayed type hypersensitivity reactions.

**Recommended Books:**

1. Pelczar M.J, Kreig, N.R and Chan, E.C.S. (1985) *Microbiology*, 5<sup>th</sup> ed. Mcgraw-Hill.
2. Denye, S.P, et.al (2004) *Hugo and Russell's Pharmaceutical Microbiology*, 7<sup>th</sup> ed. Blackwell.
3. Reed, G. (2004) *Prescott and Dunn's Industrial Microbiology*, 4<sup>th</sup> ed. CBS Publishers.
4. Purohit, S.S, et.al (2008) *Pharmaceutical Microbiology*, Student Edition. Agrobios.
5. Jain, N.K (2005) *Pharmaceutical Microbiology*, 2<sup>nd</sup> ed. Vallabh Prakashan.
6. Harris, M. (1965) *Pharmaceutical Microbiology*. Bailliere, Tindall and Cox.
7. Choudhury, M.R (1999) *Modern Medical Microbiology*. Bishwa Parichaya.
8. Stanier, R.Y (1999) *General Microbiology*, 5<sup>th</sup> ed. Macmillan.
9. Tortara G.J, et.al (2016) *Microbiology: An Introduction*, 12<sup>th</sup> ed. Pearson.
10. Salle, A.J, (2007) *Fundamental Principles of Bacteriology*. Envins Press.

<b>Course Code: PHARM-2409</b>		
<b>Course Title: Pharmaceutical Analysis-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about different principles, chemical and physical techniques and their applications used for the identification and estimation/standardization of drugs.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Choose proper analytical tools and sampling techniques.
- Explain different type titration methods and their applications.
- Estimate various compounds quantitatively and qualitatively.

**Section-A (Mid-term: 30 Marks)**

1. **Introduction and Techniques of Pharmaceutical Analysis:**
- a) Introduction: Selection of samples, selection of chemicals.
  - b) The art and science of pharmaceutical analysis.
  - c) Choosing the tools, identification of containers, filtration, ignition of precipitates, drying of samples, recording results.
2. **Aqueous Acid Base Titration:** Definitions, Distribution of acid-base species with pH of the medium, acid-base titrimetry for determination of weakly acidic and basic pharmaceuticals, indicators (theories) and their selection, applications.

**Section-B (Final Exam: 50 Marks)****Group-A (20 Marks)**

3. **Non-Aqueous Acid Base Titrimetry:** Theoretical considerations and principles, Bronsted Lowery of acids and bases. non-aqueous solvents, titration of weak acids and weak bases, applications and scope of non-aqueous titrations.
4. **Oxidation Reduction Titration:** Principles and concepts, determination involving potassium permanganate, potassium dichromate and potassium bromated, iodometric determination, miscellaneous oxidation and reduction titrations, indicators applications.

**Group-B (30 Marks)**

5. **Complexometric Titration:** Introduction to complexometric titration. complexes and chelates, stability of complex ions. Titration based on complex formation, types of complexometric titrations. Technique employed in chelometric titration, methods of end point detection, titration selectivity and masking reagents.
6. **Aquametry:** Principle and scope. Physical methods of water determination, Chemical methods of water determination, Karl-Fischer procedure: Principle, chemistry, methodology, equipment, end point detection and limitations.

**Recommended Books:**

1. Chatten, L.G. (2010) *Pharmaceutical Chemistry*, Volume 1 and 2. Mercel Dekker/CBS Publishers.
2. Watson, D.G (2016) *Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
3. Field L.D, Sternhell S, Kalman J.R. () *Organic Structure from Spectra*. Wiley.
4. Pavia D. L, et.al (2015) *Introduction to Spectroscopy*, 5<sup>th</sup> ed. Cengage learning.
5. Fleming I and Williams D.H (2007), *Spectroscopic Methods in Organic Chemistry*, 6<sup>th</sup> ed. McGraw-Hill.
6. Jeffery, G.H, et.al (1989) *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> ed. Pearson.
7. Sharma, Y.R (2007), *Elementary Organic Spectroscopy*, 4<sup>th</sup> ed. S.Chand and Company.
8. Willard et.al, (1989) *Instrumental Methods of Analysis*, 7<sup>th</sup> ed.
9. Siddiqui, A.M (2013) *Practical Pharmaceutical Chemistry*. CBS Publishers.
10. WHO (1986) *Basic Tests of Pharmaceuticals*. World Health Organization.

<b>Course Code: PHARM-2410</b>		
<b>Course Title: Pharmaceutical Analysis-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To know techniques for the assay of pharmaceutical products using non-aqueous titration, acid-base titration, complexometric titration and UV analysis.

**Course Outcomes:** At the end of the course, the student will be able to:

- Determine potency of different pharmaceutical active ingredients.
- Familiarize with common assay techniques like titration, UV analysis.

**Experiments:**

1. Determination of potency of amoxicillin (Titration)
2. Determination of potency of ferrous sulphate (Titration)
3. Determination of potency of chloroquine phosphate (Titration)
4. Estimation of potassium chloride in supplied sample (Titration)
5. Determination of potency of aspirin (Titration)
6. Determination of potency of paracetamol (UV Analysis)
7. Determination of potency of diclofenac sodium (UV Analysis)
8. Determination of potency of ranitidine HCl (UV Analysis)
9. Determination of potency of calcium carbonate (Titration)

<b>Course Code: PHARM-2413</b>		
<b>Course Title: Oral Assessment-II</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 00</b>	<b>Total Hours: 00</b>

**Course Objectives:**

- To ensure comprehension of the topics covered in class and in the reports.
- To improve students' presentation and communication skills.
- To preparing students for the types of oral assignments required in future linguistic course.

**Course Contents:** Previous courses of this syllabus, basic knowledge and miscellaneous.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain deeper insights on the topics covered courses.
- Enhance students' self-confidence for the future viva-voce.

<b>Course Code: URBL-2401</b>		
<b>Course Title: Functional Bengali Language</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** The objective of this course is to enlighten the learners with a comprehensive skill on Bangla Language with emphasis on correct sound system; pronunciation skills; the IPA system; problem sounds; vowels; consonant and diphthongs; lexical and syntactic stress and all other grammatical rules for interpersonal communication and the interpretation and production of the language in written and oral forms. This course examines the history and developments of Bengal literature with the contributions of prominent literate personalities to the development of Bangla language and literature from early age to modern time.

**Course Outcomes:** By studying this course the learners will be able to adopt the principle structures of Bangla language in a systematic and coherent manner and, at the same time, make reading and articulation, pronunciation, spelling knowledge, vocabulary, and linguistic skills and tools that are needed to work and succeed in the language. The students will also be able to estimate the successive development of Bangla language and literature, and students will learn specialized Bangla in academic terminology and acquire the language skills needed to understand and discuss, in speaking and writing, topics within a professional environment.

**Section-A (Mid-Term Examination: 30 Marks)****cÖv#qvwMK evsjv : 20**

1. evsjv fvlvi D™ ċe l mvaviY cwiPq |
2. evsjv eY© l aŸwb cwiPq |
3. evsjv evbvb : Y-Zj weavb, l-Zj weavb l cÖwgZ evsjv evbv#bi wbqg |
4. cwiflv |

**evsjv mvwnZ" : 10**

1. M" : (K) †cv÷ gv÷vi, gymjgvbx Mí (iex`abv\_ VvKzi)  
(L) Ziæ#bi mvabv, †hše#bi Mvb (KvRx bRiæj Bmjvg)

**Section-B (Final Examination: 50 Marks)****cÖv#qvwMK evsjv : 30**

1. kã cÖKiY |

2. mgvm | cÖK...wZ-cÖZ`q |
3. evK` cÖKiY |
4. cÖwZeY@xKiY (IPA) cwiwPwZ |
5. mvivsk, mvigg@, fve mæú@mviY |
6. cî wjLb |

### evsjv mvwnZ` : 20

1. evsjv mvwnZ`i BwZnm (cÖvPxb, ga` | AvaywbK hyM)
2. KweZv : (K) e½f~wgi cÖwZ (gaym~`b `Ë)  
(L) †mvbviZix (iex>`@bv\_ VvKzi)  
(M) mvg`ev`x (KvRx bRiæj Bmjvg)  
(N) AvRvb (Kvq†Kvev`)

### Recommended Books:

1. iex>`@bv\_ VvKy, Mí,"Q, wek| fviZx, KjKvZv |
2. KvRx bRiæj Bmjvg, AwMœexbv, meÿ@nviv, mwÂZv, Bmjvgx KweZv, MRj | cÖeÜ Ges Kve` Avgciv |
3. gynvæ§` knx`yjðvn, ev½vjv fvlvi BwZe,,Ë, knx`yjðv iPbvejx 3q LÛ, ev.G. XvKv-1995 |
4. gynvæ§` knx`yjðvn, ev½vjv e`vKiY, H |
5. b†ib wek|vm, evsjv D`PviY Awfavb, ev.G. |
6. †R`vwZf~lb PvKx, evsjv fvlvi e`vKiY, KjKvZv, Avb>` cvewj†Kkb, 1996 |
7. Gvneyeyj nK, evsjv evbv†bi wbqg |
8. cÖwgZ evsjv, evbv†bi wbqg |
9. W. †gv: gvQD`yi ingvb, evsjv fvlvq Bmjvgx mvwnZ` PP@v- wc.GandBP.wW w\_wmm, XvKv wek|we``vjq |
10. Av: gvbœeb %omq`- KvRx bRiæj ! Kwe | KweZv |

## Fifth Semester

<b>Course Code: PHARM-3501</b>		
<b>Course Title: Pharmaceutical Technology-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To develop a comprehensive understanding of pharmaceutical processing and manufacturing technologies, quality evaluation as well as Good Manufacturing Practice (GMP) considerations of tablet, coating, capsule and suppository.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand formulation and production process of tablet, capsule and suppository.
- Describe evaluation and quality control process of tablet, capsule and suppository.
- Know tablet coating and microencapsulation techniques.
- Explain problems and remedies associated with tablet and capsule production as well as tablet coating.

### **Section-A (Mid-term: 30 Marks)**

- 1. Formulation and Manufacturing of Tablets:** Definition, advantages and disadvantages of tablet dosage form, types of tablet. Evaluation of tablets: general appearance, size and shape, organoleptic properties, hardness and friability, weight variation, disintegration time, dissolution time; mechanism of tablet disintegration and dissolution. Tablet granulations and manufacturing: basic characteristics of granules, granulation properties, manufacturing of granules by dry granulation method (direct compression and compression granulation) and wet granulation method, advantages and disadvantages of different processes. Tablet compression machines: basic components, auxiliary components, operational process of single-punch and rotary tablet press. Tablet processing problems (causes and remedies).

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 2. Pharmaceutical Capsules:** Definition and classifications of capsules, advantages and limitations of capsule dosage form.
  - a) Hard gelatin capsules:** Definition, types, advantages and limitations, properties; gelatin and its manufacture, manufacture of hard capsule shells, formulation of capsules, capsule filling machines, tooling and accessories, problems and remedies in capsule manufacturing, quality control, packaging of capsules etc.
  - b) Soft gelatin capsules:** Definition, different size and shapes, advantages and limitations, properties, formulation, manufacturing, quality control and packaging of soft capsules. Problems and remedies of soft capsule manufacturing.
- 3. Microencapsulation Technology:** Purpose, fundamental considerations, core materials and coating materials of microencapsulation, methods of preparation, evaluation, pharmaceutical and biological applications of microencapsulation process. Pharmaceutical Pelletization: definition, advantages, disadvantages, preparation techniques, future development.

#### **Group-B (30 Marks)**

- 4. Tablet Coating:** Definition and objectives of coating, classifications of coating methods, advantages and disadvantages of coated tablets. Methods of coating: Sugar coating (different stages of sugar coating, problems of sugar coating), film coating (theory of film coating, film formers, plasticizer, solvents), enteric coating (enteric coating polymers, formulations of enteric coating), dry coating/compression coating; comparison between

sugar coating and film coating, aqueous film coating techniques, modern film coating materials and coating formulations, problems of organic and aqueous film coating. Coating machines: conventional coating machines, perforated coating machines, fluidized coating machines etc.

- 5. Suppositories:** Drug absorption from colon, classification of suppositories, suppository bases, formulation of suppositories, manufacturing of suppositories, quality control of suppositories, packaging and labeling.

**Recommended Books:**

1. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
2. Ansel, H.C and Allen, L.V. (2003) *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*, 10<sup>th</sup> ed. Lippincott Williams and Wilkins.
3. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
4. Carter, S. J (2005), *Cooper and Gunn's Tutorial Pharmacy*, CBS Publishers and Distributors.
5. Gupta, A.K (2004), *Introduction to Pharmaceutics*, Vol. I and II, 3<sup>rd</sup> ed. CBS Publishers.
6. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
7. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
8. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
9. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
10. Sheskey, P.J, et.al (2017) *Handbook of Pharmaceutical Excipients*, 8<sup>th</sup> ed. Pharmaceutical Press.
11. Dittert, L.W et.al (1975) *Sprowls' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: PHARM-3502</b>		
<b>Course Title: Pharmaceutical Technology-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical experience in formulation of granules, ORS, tablet, capsule and suppository; in process quality evaluation.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain production experience on dosage forms like tablet and capsule.
- Learn wet and dry granulation process.
- Demonstrate evaluation process of different dosage forms.
- Know condition of storage, labeling system of pharmaceutical products.

**Experiments:**

1. Study of hand operating capsule machine.
2. Study of hand operating single punch tablet machine.
3. Preparation of effervescent granules.
4. Preparation of oral rehydration solution (ORS).
5. Preparation of hard gelatin capsule.
6. Preparation of wet granules of paracetamol BP for compression of paracetamol tablet.
7. Compression of paracetamol tablet.
8. Preparation of antacid tablet.
9. Hardness and friability tests of tablets.
10. Weight variation test of different tablets.
11. Weight variation test of hard gelatin capsules.
12. Determination of different empty hard gelatin capsule shell size.

<b>Course Code: PHARM-3503</b>		
<b>Course Title: Biopharmaceutics and Pharmacokinetics-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide a preliminary idea about the factors that influences the absorption, distribution, elimination and bioavailability of a drug in the body and the application of this knowledge to obtain the expected therapeutic effect of the drug product.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand ADME, plasma protein binding and bioavailability of drugs in the body.
- Explain different factors which affect the drug absorption from the GIT.
- Correlate between in vitro and in vivo studies of different parameters of dosage forms.
- Know pharmacokinetic and bioavailability variations in disease state.

### **Section-A (Mid-term: 30 Marks)**

- 1. Introduction to Pharmaceutics and Biopharmaceutics:** ADME, pharmacokinetics, clinical pharmacokinetics, pharmacodynamics, concept of bioavailability, concept of biopharmaceutics, applications of biopharmaceutics and pharmacokinetics, toxicokinetics and clinical toxicology, measurement of drug concentrations, plasma level-time curve, significance of measuring plasma drug concentrations, basic pharmacokinetics and pharmacokinetic models etc.
- 2. Gastrointestinal Absorption of Drugs:**
  - a) Biological Consideration: Membrane physiology, gastrointestinal physiology, mechanism of absorption etc.
  - b) Physicochemical Consideration: pKa and gastrointestinal absorption, pH-partition theory and other physicochemical factors.
  - c) Dosage form consideration: Role of different dosage form like solution, suspension, tablet, capsule, emulsion etc. on gastrointestinal absorption.
  - d) Disintegration and dissolution of drugs.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 3. Distribution of Drugs:**
  - a) Important Pharmacokinetic Parameters: Biological half-life, apparent volume of distribution, area under the curve, absorption and elimination rate constant etc.
  - b) Interpretation of drug-plasma level curve.
  - c) Drug-Protein Interaction: Theoretical aspect of protein-drug interaction, methods used for protein binding, identification of drug binding sites, kinetics of protein binding, determination of bindings sites and association constant, factors affecting protein binding, effects of protein binding on drug distribution, elimination and pharmacological effects of drugs.

#### **Group-B (30 Marks)**

- 4. Drug Clearance:**
  - a) Theoretical aspects of drug elimination, excretion and biotransformation.
  - b) Renal Elimination: Glomerular filtration, active tubular secretion, tubular reabsorption. Determination of renal clearance.
  - c) Biotransformation of Drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (Michelis-Menten equation), hepatic

elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance- relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance).

d) Biliary excretion of drug.

**5. Bioavailability and Bioequivalence:** Definitions of different parameters relative to bioavailability, purpose of bioavailability, relative and absolute bioavailability, methods of assaying bioavailability, criteria for bioequivalence studies, drug product selection on the basis of bioavailability testing.

**Recommended Books:**

1. Shargel, L. (2012) *Applied Biopharmaceutics and Pharmacokinetics*, 6<sup>th</sup> ed. McGraw-Hill.
2. Gibaldi, M. (1977), *Biopharmaceutics and Clinical Pharmacokinetics*. Lea and Fibiger.
3. Notari, R. E. (1986) *Biopharmaceutics and Clinical Pharmacokinetics*, 4<sup>th</sup> ed. CRC Press.
4. Wagner, J. G. (1971) *Biopharmaceutics and Relevant Pharmacokinetics*. Hamilton, Ill.
5. Cadwallader D.E. (1983) *Biopharmaceutics and Drug Interactions*, 3<sup>rd</sup> ed. Raven Press.
6. Gibaldi, M. and Perrier, D. (1982), *Pharmacokinetics*, 2<sup>nd</sup> ed. Informa.
7. Rosenbaum, S.E. (), *Basic pharmacokinetics and Pharmacodynamics*. Wiley.
8. Hiremath S.R.R (2012) *Textbook of Biopharmaceutics and Pharmacokinetics*. Prism Publications.
9. Burton M. E, et.al. (2005) *Applied Pharmacokinetics and Pharmacodynamics: Principles of Therapeutic Drug Monitoring*, 4<sup>th</sup> ed. Lippincott Williams and Wilkins.

<b>Course Code: PHARM-3504</b>		
<b>Course Title: Biopharmaceutics and Pharmacokinetics-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To study bio-availability, disintegration time and dissolution rate of various dosage forms.

**Course Outcomes:** At the end of the course, the student will be able to:

- Know pH effect on disintegration of tablets/capsules.
- Familiar with disintegration and dissolution machines.
- Understand test process of disintegration and dissolution of different dosage forms.

**Experiments:**

1. Preparation of gastric simulated fluid (GSF) and intestinal simulated fluid (ISF).
2. Effect of pH on disintegration of tablets/capsules.
3. Disintegration test of the uncoated tablet: Paracetamol, Chlorpheniramine.
4. Disintegration test of the enteric coated tablets.
5. Disintegration test of the effervescent tablets: Aspirin.
6. Disintegration test of the capsule.
7. Dissolution study of the conventional paracetamol tablet.
8. Dissolution study of the conventional ibuprofen tablet.
9. Dissolution study of paracetamol from combined dosage form.
10. Dissolution study of sulfamethoxazole tablet.

<b>Course Code: PHARM-3505</b>		
<b>Course Title: Pharmacology-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about the pharmacodynamics and pharmacokinetics properties, mechanism of action, adverse effects, toxicity and dosage of cardiovascular, CNS and ANS acting, antimicrobial, antifungal, antiviral agents and anesthetic.

**Course Outcomes:** After completion of the course, the student will be able to:

- Demonstrate the signaling pathway of various receptors in human body.
- Understand the pharmacological actions of different categories of drugs.
- Explain the mechanism of drug action at cellular/macromolecular levels.
- Apply the basic pharmacological knowledge in the rationale usage of antibiotics, drug resistance.

### **Section-A (Mid-term: 30 Marks)**

- 1. Signaling Mechanism and Drug Action:** Cellular communication, signal transduction pathway, transmembrane signaling, ligand regulated transmembrane enzymes, ligand-andvoltage- gated channels, G-proteins and secondary messengers: cyclic-AMP, calcium and phosphoinositides and cyclic-GMP, receptor classes and drug development.
- 2. Cholinergic and Anticholinergic Drugs:** Cholinergic agonists: direct and indirect acting; Cholinergic antagonist: antimuscarinic agents, ganglionic blockers, neuromuscular blockers.
- 3. Adrenergic and Antiadrenergic Drugs:** Adrenergic agonist: direct and indirect acting; Adrenergic antagonist:  $\alpha$ -blockers,  $\beta$ -blockers.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 4. Cardiovascular Drugs:** Types, causes, pathophysiology, complications and treatment of hypertension; regulation of blood pressure. Mechanism of actions, clinical uses, side effects, contraindications and dosage of-
  - a) Antihypertensive drugs
  - b) Antianginal drugs
  - c) Antiarrhythmic drugs
  - d) Diuretics
  - e) Drugs used in heart failure
- 5. Anticoagulants:** Oral anticoagulants, thrombolytic agents, heparin, calcium complexing agents.

#### **Group-B (30 Marks)**

- 6. Antibacterial/Antimicrobial Agents:**
  - a) Drugs affecting folate synthesis sulfonamide, trimethoprim
  - b)  $\beta$ -lactam antibiotics: Penicillin, cephalosporin.
  - c) Drugs affecting protein synthesis: Tetracycline, chloramphenicol, macrolides, aminoglycosides.
  - d) Drugs affecting Topoisomerase-I enzyme: Fluoroquinolones.
  - e) Glycopeptide, polymyxin, bacitracin and nitrofurantoin antibiotics.
  - f) Antitubercular agents: Isoniazid (INH), rifampin, ethambutol, pyrazinamide, capreomycin, cycloserine, ethionamide.
  - g) Antileprotic drugs: Dapson, rifampin, clofazimine.

7. **Antifungal Drugs:** Amphotericin-B, flucytosine, itraconazole, ketoconazole, fluconazole, nystatin, griseofulvin etc.
8. **Antiviral Drugs:** Anti-herpes virus, anti-retrovirus, anti-influenza virus.
9. **Anesthetic:**
  - a) **Local Anesthetic:** Types, mechanism of action, properties, SAR, pharmacological action, fate of ester and amide type local anesthetics.
  - b) **General Anesthetic:** Inhaled anesthetics: Nitrous oxide, halothane, enflurane, isoflurane and sevoflurane. Intravenous anesthetics: Barbiturates, benzodiazepines and opioid analgesics, propofol, ketamine.

**Recommended Books:**

1. Rang, H.P, Dale, M.M, et.al (2015) *Rang and Dale's Pharmacology*, 8<sup>th</sup> ed. Churchill Livingstone.
2. Katzung, B.G, et.al (2009) *Basic and Clinical Pharmacology*, 11<sup>th</sup> ed. Lange/McGraw-Hill.
3. Brunton, L.L, et.al (2006) *Goodman and Gillman's Pharmacological Basis of Therapeutics*, 11<sup>th</sup> ed. McGraw-Hill.
4. Satosker, R.S, et.al (2005) *Pharmacology and Pharmacotherapeutics*, 19<sup>th</sup> ed. Popular/ Elsevier India.
5. Finkel, R, et.al (2009) *Pharmacology*, 4<sup>th</sup> ed (Lippincott's Illustrated Reviews). Lippincott/LWW.
6. Tripathi, K.D (2013) *Essentials of Medical Pharmacology*, 7<sup>th</sup> ed. Jaypee Brothers.
7. Bennett, P.N and Brown M.J (2003) *Clinical Pharmacology*, 9<sup>th</sup> ed. Churchill Livingstone.
8. Misbahuddin, M and Islam, M.R (1998) *General Principle of Pharmacology*, 4<sup>th</sup> ed. Books and Allied.
9. Khan, A.R () *Essentials of Medical Pharmacology*.
10. Herfindal, E.T and Hirschman, J.L (1992) *Clinical Pharmacy and Therapeutics*, 4<sup>th</sup> ed. Williams and Wilkins.
11. Luellman, H, Mohr, K, Hein, L (2017) *Color Atlas of Pharmacology*, 5<sup>th</sup> ed. Thieme.

<b>Course Code: PHARM-3506</b>		
<b>Course Title: Pharmacology-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To investigate various pharmacological actions of pharmaceutical products on mice/rats model and to measure glucose level and drug concentrations from human blood samples.

**Course Outcomes:** At the end of the course, the student will be able to:

- Introduce different routes of administration.
- Observe different pharmacological activities of drugs on mice/rats.
- Estimate glucose level and drug concentrations from blood samples by UV spectrophotometric method.

**Experiments:**

1. Introduction to different routes of administration of drugs in experimental animals.
2. Study of the effects of diuretics and antidiuretics on the rate of urinary flow in rats/mice.
3. Study of CNS acting drugs on mice.
  - a) CNS stimulants (strychnine/ ephedrine /amphetamine)
  - b) CNS depressants (barbiturate-induced sleeping time)
4. Investigation of pharmacological action of ayurvedic drugs on CNS.
5. Estimation of blood glucose at fasting/after meal condition by chemical method.
6. Estimation of aspirin after oral administration by UV spectrophotometric method.
7. Estimation of paracetamol after oral administration by UV spectrophotometric method.

<b>Course Code: PHARM-3507</b>		
<b>Course Title: Medicinal Chemistry-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide knowledge on discovery and synthesis of drugs from nature and in the laboratory, chemistry of natural products, structural modifications to increase potential activity or minimize toxicity of the parent molecules as well as design and development of new drugs.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Learn ancient link between religion and medicine.
- Explain different name reactions with their mechanisms and applications in drug synthesis.
- Know structure determination, synthesis and physiological activities of a number of naturally occurring drugs.

### **Section-A (Mid-term: 30 Marks)**

- 1. Introduction to Medicinal Chemistry:** History, purpose, medicinal uses of drugs, place of drug synthesis, pharmacodynamic agents, dietary factors in medicine, future economics of medicinal drugs and application of computer in medicinal chemistry.
- 2. Heterocyclic Compounds of Medicinal Interest:**
  - a) 5-membered heterocyclic compounds:** Pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole and isothiazole: their properties, reactions and pharmaceutical importance.
  - b) 6-membered heterocyclic compounds:** Pyridine, piperidine, pyrimidine, pyradazine, pyrazine and triazine: their properties, reactions and pharmaceutical importance.
  - c) Benzofused 5-membered heteroaromatic compounds:** Indole, benzofuran, benzothiaphene and carbazole: their properties, reactions and pharmaceutical importance.
  - d) Benzofused 6-membered heteroaromatic compounds:** Quinoline and isoquinoline: their properties, reactions and pharmaceutical importance.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 3. Name Reactions:** Baeyer-Villiger reduction, Clemmensen reduction, Diels Alder reaction, Friedel-Crafts alkylation and acylation reaction, Gabriel synthesis, Gattermann-Koch and Sandmeyer reaction, Grignard reaction, Hoffman degradation reaction, Mannich reaction, Michael and Meerwin Pundorf-Verley reduction, Oppenauer oxidation, Perkin reaction, Reformatsky reaction, Reimer-Tiemann reaction, Wittig and Wolf-Kishner reduction.

#### **Group-B (30 Marks)**

- 4. Chemistry of Natural Products:**
  - a) Alkaloids:** Occurrence, isolation, classification and properties of alkaloids, structure determination, synthesis and physiological activities of ephedrine, nicotine, atropine and morphine and pharmaceutical application.
  - b) Terpenoids:** Occurrence, isolation and classification, synthesis of geraniol, citral ionones and amyryl and pharmaceutical application.
  - c) Vitamins:** Occurrence, classification and general methods of isolation of vitamins, structure determination, synthesis and biological functions of vitamin-A, vitamin -B and vitamin-C, and pharmaceutical application.

**d) Antibiotics:** Occurrence, isolation, structure determination, synthesis and clinical properties of penicillin, streptomycin, chloramphenicol and tetracycline and pharmaceutical application.

**Recommended Books:**

1. Patrick, G.L. (2006), *An Introduction to Medicinal Chemistry*, 3<sup>rd</sup> ed (1<sup>st</sup> Indian ed). Oxford Univ. Press.
2. Williams, D.A and Lemke, T.L (2002) *Foye's Principles of Medicinal Chemistry*, 5<sup>th</sup> ed. Lippincott.
3. Kar, A. (2007) *Medicinal Chemistry*, 4<sup>th</sup> ed. New Age Publishers.
4. Joule, J. A, Smith G. F, Mills, K (2010) *Heterocyclic Chemistry*, 5<sup>th</sup> ed. Wiley-Blackwell.
5. Alagarsamy, V. (2013) *Textbook of Medicinal Chemistry*, Vol I and II, 2<sup>nd</sup> ed. Elsevier India.
6. Abraham, D.J and Rotella, D.P (2010) *Burger's Medicinal Chemistry, Drug Discovery and Development*, Vol 1-8, 7<sup>th</sup> ed. Wiley.
7. Smith, H.J (2005) *Smith and Williams' Introduction to the Principles of Drug Design and Action*, 4<sup>th</sup> ed. CRC Press.
8. King, F.D (2002) *Medicinal Chemistry: Principles and Practice*, 2<sup>nd</sup> ed. Royal Society of Chemistry.
9. Beale, J.M and Block, J.H (2010) *Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 12<sup>th</sup> ed. Lippincott Williams and Wilkins.
10. Morrison, R.T and Boyd, R.N (2002) *Organic Chemistry*, 6<sup>th</sup> ed. Prentice-Hall.
11. Agarwal O. P (2014) *Organic Chemistry: Natural Products*. Krishan Prakashan.

<b>Course Code: PHARM-3508</b>		
<b>Course Title: Medicinal Chemistry-I Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To practically know about synthesis of drug and drug intermediates.

**Course Outcomes:** At the end of the course, the student will be able to:

- Synthesize drug such as paracetamol, benzocaine, metronidazole.
- Produce drug intermediates such as PABA.

**Experiments:**

1. Synthesis of drug and drug intermediates
  - a) Paracetamol
  - b) Benzocaine
  - c) Metronidazole
2. Synthesis of drug and drug intermediates
  - a) Aspirin
  - b) Phenacetin
  - c) PABA
  - d) Niclosamide

<b>Course Code: PHARM-3509</b>		
<b>Course Title: Pharmaceutical Biotechnology</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To gather appropriate knowledge of and ability to apply approaches, techniques and methods in the various sectors of pharmaceutical biotechnology for the design and optimization of drugs, cosmetics, diagnostics, vaccines and other biopharmaceuticals.

**Course Outcomes:** After completion of the course, the student will be able to:

- Explore ideas and applications of Pharmaceutical Biotechnology.
- Optimize upstream and downstream processing of fermentation process.
- Understand recombination of genetic materials and applications.
- Explain mechanism, delivery, formulation, production process of biopharmaceuticals.

### Section-A (Mid-term: 30 Marks)

- 1. Introduction of Biotechnology:** Biotechnology and its application in medicine, foods, forensic science, microbial and plant genetics; different dimension of biotechnology and pharmaceutical biotechnology.
- 2. Recombinant DNA Technology and Production of Biotech Compounds:** Basic principle, genetic recombination; gene expression, cloning techniques and methods, cloning vectors, restriction endonuclease, ligase and other enzymes used in gene cloning, transfection method; knockout and transgenic animals. Cultivation and downstream processing, issues to consider in production and purification of proteins.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Fermentation:** General consideration: Introduction and historical perspectives; The fermentation process and optimization; Improvement of microbial strain-Mutations, recombination, protoplast fusion; Bioreactors and fermenters: types, structure, size, culture vessel, agitation systems, process monitoring and control, cleaning and sterilization.
- 4. Delivery of Protein Drugs:** Protein structure, protein folding; Approaches for rate controlled and target site specific delivery.

#### Group-B (30 Marks)

- 5. Gene Therapy:** Ex vivo versus in vivo gene therapy, potential target diseases for gene therapy, gene transfer methods, viral and non-viral gene transfer.
- 6. Pharmaceutical Production:** Short study of current biotech products: Interleukins and interferons, insulin, vaccines, monoclonal antibody-based pharmaceuticals, follicle stimulating hormone (FSH), trastuzumab. Dispensing of biotechnology products: Storage-temperature requirements, storage in dosing and administration devices, light protection, handling, mixing and shaking, travel requirements, preparation and administration.

#### Recommended Books:

1. Crommelin, D., Sindelar, R.D, Meibohm, B. (2007) *Pharmaceutical Biotechnology*, 3<sup>rd</sup> ed. CRC Press.
2. Vyas, S.P, Dixit, V.K (2011) *Pharmaceutical Biotechnology*, 1<sup>st</sup> ed. CBS Publishers.
3. Jain, S.K (2006) *Textbook of Biotechnology: Fundamentals of Molecular Biology*. CBS Publishers.
4. Rho, J.P and Louie, S.G (2003) *Handbook Pharmaceutical Biotechnology*, 1<sup>st</sup> ed. CRC Press.
5. Kulkarni, G.T (2002) *Biotechnology and Its Applications in Pharmacy*. Jaypee.
6. Kenneth, E.A and Wu, V.L (2002) *Biotechnology and Biopharmaceutical: Manufacturing, Processing and Preservation*, Vol.2. CRC.
7. Elliot, W.H and Elliot, D.C (2009) *Biochemistry and Molecular Biology*, 4<sup>th</sup> ed. Oxford University Press.
8. Clark, D.P and Russell, L.D (2010) *Molecular Biology Made Simple and Fun*, 4<sup>th</sup> ed. Cache River.
9. Kar, A. (2003) *Pharmacognosy and Pharmacobiotechnology*, New Age Publishers.
10. Rodwell, V.W, et.al (2015) *Harper's Illustrated Biochemistry*, 30<sup>th</sup> ed. Lange/McGraw-Hill.
11. Deb, A. C. (2001) *Fundamentals of Biochemistry*, 9<sup>th</sup> ed. New Central Book.

<b>Course Code: URED-3503</b>		
<b>Course Title: Introduction to Political Thoughts and Social Behavior</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** This course is designed:

- To provide the students with basic idea concerning the political thoughts and social justice.
- To inculcate in them Islamic manners and etiquettes for their development as a human being.
- To discharge their duties and responsibilities towards Allah (SWT) and His creatures.

**Course Outcomes:** After completion of this course:

- The students will be equipped with the basic idea of political thoughts and human development in Islam.
- They will be able to establish a society on the basic of social justice and to run it according to the direction of Islam.
- They will be able to perform their duties and responsibilities towards Allah (SWT) and His creatures.

### **Section-A (Mid-term Exam: 30 Marks)**

**1. Introduction to Political Thoughts:**

**Government and Politics:** Meaning and Organs

**Islamic Political System:** Meaning, Importance and Principles

**2. Shari'ah (Islamic Law):** Meaning, Sources and Differences between *Shari'ah* and Manmade Law

**Constitution:** Definition, Islamic Constitution and Special Features of an Islamic Constitution

**3. Islamic State:** Concept of Islamic State, Differences between Islamic and Secular State, Necessity of Islamic State, Main Organs of Islamic State, Principles of Islamic State

**The Executive (Head of the state):** Conception, Qualifications, How to select a Head of the State, Factions of the Executive.

### **Section-B (Final Exam: 50 Marks)**

**4. Legislative (Al-Shura):** Meaning, Importance, Example and Functions

**The Judiciary (Al-Qada'):** Meaning, Importance, Nature and Implementation, Types of Punishment

**Citizenship (Nationality):** Meaning, Types, Rights

*Hisbah:* Meaning, Importance, Objectives, Functions and Selection of *Mushtasib*

**5. Social Behavior:**

**Dealings and Behavior in Islam (Mu'amalah):** Its Meaning, Definition and Scope.

**Family life in Islam:** (a) Role of Marriage as the basis of Islamic Family (b) Status of women in Islam, comparison with other religion (c) Rights and duties of women in Islam (d) Husband-wife relations (Duties and obligations to each other) (e) Rights of children in Islam (f) Duty towards Parents.

**6. Principles of Islamic Economic System:** (a) Earning and expenditure by *Halal* means (b) Right to own property and individual liberty (c) System of *Zakah* (d) Prohibition of interest (*Riba*) (e) Law of Inheritance (*Mirath*) (f) Various Islamic transactions.

**7. Political System:** Definition, Principals, Islamic State, Islamic monuments.

**Dress code:** Dress code in Islam for male and female

**Duties and obligations towards:** Relatives, Neighbors, Guests, Needy and Orphan.

**8. Basic virtues and Islam,** Duties of the Muslims to each other

(1) Honesty (2) Truthfulness (3) Kindness (4) Perseverance (5) Firmness against evil (6) Tolerance (7) Punctuality (8) Courage (9) Trustworthiness (10) Forgiveness (11) Chastity for women (12) Intention (13) Modesty (14) Charity (15) Gifts (16) Thankfulness (17) Visiting the sick.

Vices, Greediness, Jealousy, enviousness, hatred etc.

**Social Manners:** (1) Brotherhood (2) Greetings (3) Co-operation (4) Meetings (5) Talking (6) Keeping promises (7) Asking permission before entering someone's house. Welfare.

**Recommended Books:**

**Introduction to Political Thoughts:**

1. Ansari, Jalal, *Introduction to the Systems of Islam*, London, Al-Khilafah Publications, ISBN-1899574026.
2. Asad, Mohammad, *Basic principles of state and Government in Islam* (California; Southern California University Press.
3. Matin, Abdur Rashid and Sirajul Islam, *Introduction to Political Science*.
4. Sherwani, H.K. *Studies in Muslim Political Thought and Administration*, Muhammad Ashraf, 1945, Lahore.
5. Mohammad Shafiul Alam Bhuiyan, *The Government and Politics in Islam*, Noor Publications, 4<sup>th</sup> edition, 2016, Dhaka-1000.

**Social Behavior:**

1. Abdul Hannan, Shah, *Social Laws of Islam*, BIIT, Dhaka, 1995.
2. Abdalati, Hammudah, (1977), "*The Family Structure in Islam*", American Trust Publications. USA.
3. Al-Minawi, Kawther M, *The Child Rights in Islam*. Riyadh: Dar al-Amal Publishing House, 1993.
4. Umer, Chapra, *Islam and the Economic Challenge*. Leicester, UK: Islamic Foundation and Virginia, USA: the International Institute of Islamic Thought, 1992.
5. Taqi, Usmani, M., *An Introduction to Islamic Finance*. Karachi, Pakistan: Idaratul Ma'arif, 1998.

## Sixth Semester

<b>Course Code: PHARM-3601</b>		
<b>Course Title: Pharmaceutical Dispensing</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather appropriate knowledge on approaches, techniques and methods of pharmaceutical compounding and dispensing for the prescription as well as optimization of doses of different dosage forms.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand fundamental operation in compounding, choice of containers and labeling of dispensed medications.
- Learn types and process of dispensing the prescription.
- Understand basics of pharmaceutical calculations and measure different doses.

### **Section-A (Mid-term: 30 Marks)**

1. **Prescription:** Definition, parts of prescription, types of prescription, procedure, sources of information, dispensing the prescription, refilled prescription, prescription pricing, and recording of prescription.
2. **Basic Principles of Compounding and Dispensing:** Definition of dispensing, general dispensing procedure, fundamental operation in compounding, current good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, labeling of dispensed medications.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

3. **Types of Dispensed Preparation:** Solutions (oral, external use, body cavities) suspensions and emulsions, ointments, creams, gels, pastes, powders and granules, suppository and pessaries, lozenges, pastilles, pills, capsules, tablets, tables triturates; pharmaceutical preparation for extemporaneous dispensing (extracts, glycerin, infusions, spirits, tinctures, waters).
4. **Dispensing of Proprietary:** Types of dispensing: manufacturer's bulk container and original pack; dispensing of preparations in special containers, bioavailability of proprietary preparations.

#### **Group-B (30 Marks)**

5. **Calculations:** Weight and measures, percentage calculations, % w/v, v/v, and w/w, alcohol dilutions, use of alligation methods; proof spirit, isotonic solutions, HLB values, mEq units, displacement value of suppositories.
6. **Posology:** Definition, factors influencing dosage, dose frequency, calculations of doses on the basis of age, sex and surface area, imperial system, Latin terms and abbreviations.

#### **Recommended Books:**

1. Carter, S.J (2008) *Cooper and Gunn's Dispensing for Pharmaceutical Students*, 12<sup>th</sup> ed. CBS Publishers.
2. Marriott, J.F, et.al (2010) *Pharmaceutical Compounding and Dispensing*, Pharmaceutical Press.
3. Allen, L.V (2016) *The Art, Science and Technology of Pharmaceutical Compounding*, 5<sup>th</sup> ed. American Pharmaceutical Association (APhA).
4. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger
5. Ansel, H.C (2012) *Pharmaceutical Calculations*, 14<sup>th</sup> ed. Lea and Febiger.
6. Gupta, A.K (2004) *Introduction to Pharmaceutics* Volume II, 3<sup>rd</sup> ed. CBS Publishers.

<b>Course Code: PHARM-3603</b>		
<b>Course Title: Biopharmaceutics and Pharmacokinetics-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To understand the concept of compartment modeling and evaluate the concentration of drug in body, multiple doses regimens and dose adjustment in renal impairment.

**Course Outcomes:** After completion of the course, the student will be able to:

- Develop concept of compartment modeling and their applications.
- Evaluate dosage regimens of the drugs using biopharmaceutical parameters.
- Know approaches for dose adjustment in renal disorders.

### Section-A (Mid-term: 30 Marks)

#### 1. Compartmental Analysis:

- a) **One compartment model:** 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 model:** 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.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

2. **Pharmacokinetics of Drug Absorption:** Zero-order absorption model, first-order absorption model, determination of absorption rates constant from oral absorption data.
3. **Multiple Doses Regimens (MDR):** Drug accumulation, repetitive intravenous injection, multiple oral doses regimens, loading dose and determination of bioavailability and bioequivalency from MDR.

#### Group-B (30 Marks)

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

#### Recommended Books:

1. Shargel, L. (2012) *Applied Biopharmaceutics and Pharmacokinetics*, 6<sup>th</sup> ed. McGraw-Hill.
2. Gibaldi, M. (1977), *Biopharmaceutics and Clinical Pharmacokinetics*. Lea and Fibiger.
3. Notari, R. E. (1986) *Biopharmaceutics and Clinical Pharmacokinetics*, 4<sup>th</sup> ed. CRC Press.
4. Wagner, J. G. (1971) *Biopharmaceutics and Relevant Pharmacokinetics*. Hamilton, Ill.
5. Cadwallader D.E. (1983) *Biopharmaceutics and Drug Interactions*, 3<sup>rd</sup> ed. Raven Press.
6. Gibaldi, M. and Perrier, D. (1982), *Pharmacokinetics*, 2<sup>nd</sup> ed. Informa.
7. Rosenbaum, S.E. (), *Basic pharmacokinetics and Pharmacodynamics*. Wiley.
8. Hiremath S.R.R (2012) *Textbook of Biopharmaceutics and Pharmacokinetics*. Prism Publications.
9. Burton M. E, et.al. (2005) *Applied Pharmacokinetics and Pharmacodynamics: Principles of Therapeutic Drug Monitoring*, 4<sup>th</sup> ed. Lippincott Williams and Wilkins.

<b>Course Code: PHARM-3604</b>		
<b>Course Title: Biopharmaceutics and Pharmacokinetics-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical knowledge about dissolution study of various dosage forms.

**Course Outcomes:** At the end of the course, the student will be able to:

- Assess rate of dissolution of different pharmaceutical dosage forms.
- Learn methods of determination of plasma protein binding.

**Experiments:**

1. Dissolution study of the conventional diclofenac sodium tablet.
2. Dissolution study of the sustained release diclofenac sodium tablet.
3. Dissolution study of the glycerin suppository.
4. Dissolution study of the diclofenac sodium suppository.
5. Comparison of disintegration of coated and uncoated diclofenac tab.
6. Determination of Binding Sites and Association constant.
7. In vitro dissolution study of SRDF theophylline capsule.
8. In vitro dissolution study of theophylline tablet.

<b>Course Code: PHARM-3605</b>		
<b>Course Title: Hospital and Community Pharmacy</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To enhance knowledge with an overview of all aspects of contemporary pharmacy practice in community and hospital, investigation of new drugs, clinical trials and rational use of drugs.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Know structure of hospital pharmacy, services and operations.
- Understand process of investigation of new drugs and their clinical trial sequence.
- Serve community regarding to rational use of drugs and primary health care.

**Section-A (Mid-term: 30 Marks)**

**1. Hospital Pharmacy:**

- Introduction:** Goals, minimum standards, abilities required for a hospital pharmacist. Hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital. Hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job descriptions.
- Pharmacy and Therapeutics Committee (PTC):** Description and purpose, membership and functions of PTC.
- Hospital Formulary:** Guiding principles, legal basis, principles for admission or deletion of drugs, selection of text.

**Section-B (Final Exam: 50 Marks)**

**Group-A (20 Marks)**

- Purchasing and Inventory Control:** Objectives, layout of store, purchasing procedures, storage; Types of inventory control: A.B.C analysis, VED analysis, EOQ, Lead Time, Buffer Stock, perishable inventory, physical inventory, perpetual inventory.

- e) **Investigational Use of Drugs:** Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee, phases of clinical trials, termination of clinical trials etc.

### Group-B (30 Marks)

- f) **Dispensing to in-patients and out-patients:** Drug distribution systems, dispensing of charge, floor stock drugs, non-floor stock drugs, mobile dispensing unit, unit dose dispensing. Dispensing to outpatients, locality of out-patient dispensing area, dispensing routine, record keeping. Dispensing during off-hours, use of nursing supervisors, emergency boxes and night drug cabinets, drug basket method, mobile dispensing unit, pharmacist-on-call. Drug charges in hospitals, pricing and break-even point pricing. Narcotics and their control.
- g) **Drug Information Centre and Library:** Physical facilities, selection of contents, methods of dissemination, role in educational and training programs, professional education, internal teaching programs, external teaching programs.
2. **Community Pharmacy:** Definition and scope of community pharmacy, primary health care (PHC), principle of PHC; organization, inventory control and management of retail pharmacy, responsibility of retail pharmacists; communication and counseling for patient compliance; role of pharmacist in community healthcare and education.
3. **Rational Use of Drugs:** Definition, background, factors underlying of irrational use of drugs, impact of irrational drug use, drug supply system, drug use pattern of develop and developing countries, situation in Bangladesh.

#### Recommended Books:

1. Hassan, W.E (1986) *Hospital Pharmacy*, 5<sup>th</sup> ed. Lea and Febiger.
2. Nand, P and Khar, R.K (2007) *Hospital and Clinical Pharmacy*. Birla Publications.
3. Ahmad, A., et.al (2011) *A Textbook of Hospital and Clinical Pharmacy*, 1<sup>st</sup> ed. CBS Publishers.
4. Allwood, M.C and Fell. J.T (2010) *Textbook of Hospital Pharmacy*. CBS Publishers.
5. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
6. Gupta, A.K (2008) *Health Education and Community Pharmacy*, 1<sup>st</sup> ed. CBS Publishers.
7. Dhillon, S and Raymond, R (2009) *Pharmacy Case Studies*, 1<sup>st</sup> ed. Pharmaceutical Press.

<b>Course Code: PHARM-3607</b>		
<b>Course Title: Medicinal Chemistry-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about design and development of newly discovered compound and optimizing their activity of interest, different stages and techniques of drug discovery.

**Course Outcomes:** At the end of the course, the student will be able to:

- Know role of medicinal chemistry in drug research.
- Learn various strategies to design and develop new lead molecule for biological target.
- Knowledge structural activity relationship of different class of drugs

### Section-A (Mid-term: 30 Marks)

1. **Drug Discovery and Design:** Source of drugs; Genesis of drugs: i) Serendipity ii) Random Screening iii) Extraction from natural sources iv) Molecular modification (general process, special process-ring closure or opening, formation of lower or higher homologues, removal, introduction or replacement of bulky groups, isosteric substitution, change of position or certain groups, introduction of alkylating moieties, modification towards inhibition or promotion of various electronic states); Methods of lead optimization (Topliss sequential method), Fibonacci search, sequential complex optimization (v) Selection or synthesis of soft drugs, soft analogues, activated soft compounds, natural soft drugs, soft drugs based on the active metabolite approach, soft

drug based on inactive metabolite approach (vi) Prodrugs (vii) Rational drugs design, antimetabolites, enzyme inhibitors.

**Section-B (Final Exam: 50 Marks)**  
**Group-A (20 Marks)**

**2. Stereochemistry:**

- a) Geometric isomerism of alkenes and cyclic compounds, cis, trans and (E), (Z) systems of nomenclature.
- b) Conformational isomers, conformation of open chain and cyclic compounds.
- c) Chirality of molecules, enantiomer, diastereomer, racemic modification, meso compound, (R) and (S) configuration, sequence rule, and optical rotation.
- d) Stereo-selective and stereo specific reaction.
- e) Pharmaceutical importance of stereochemistry study.

**Group-B (30 Marks)**

- 3. Molecular Basis of Drug Action:** Action of drug on the basis of receptor, specific and nonspecific receptors, action of drugs not mediated by receptor, factors affecting drug-receptor interaction, nature of drug-receptor interaction, role of receptor in the design of new drugs. The molecular aspect of drug receptor interaction: (a) narcotic analgesics and antagonists, (b) sulfadugs, (c) enzyme inhibitors, (d) H<sub>1</sub> and H<sub>2</sub> blockers, (e) adrenergic blockers, (f) benzodiazepine derivatives.
- 4. Drug 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.

**Recommended Books:**

1. Patrick, G.L. (2006), *An Introduction to Medicinal Chemistry*, 3<sup>rd</sup> ed (1<sup>st</sup> Indian ed). Oxford Univ. Press.
2. Williams, D.A and Lemke, T.L (2002) *Foye's Principles of Medicinal Chemistry*, 5<sup>th</sup> ed. Lippincott.
3. Kar, A. (2007) *Medicinal Chemistry*, 4<sup>th</sup> ed. New Age Publishers.
4. Alagarsamy, V. (2013) *Textbook of Medicinal Chemistry*, Vol I and II, 2<sup>nd</sup> ed. Elsevier India.
5. Abraham, D.J and Rotella, D.P (2010) *Burger's Medicinal Chemistry, Drug Discovery and Development*, Vol 1-8, 7<sup>th</sup> ed. Wiley.
6. Smith, H.J (2005) *Smith and Williams' Introduction to the Principles of Drug Design and Action*, 4<sup>th</sup> ed. CRC Press.
7. King, F.D (2002) *Medicinal Chemistry: Principles and Practice*, 2<sup>nd</sup> ed. Royal Society of Chemistry.
8. Terrett, N.K (1998) *Combinatorial Chemistry*. Oxford University Press.
9. Beale, J.M and Block, J.H (2010) *Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 12<sup>th</sup> ed. Lippincott Williams and Wilkins.
10. Morrison, R.T and Boyd, R.N (2002) *Organic Chemistry*, 6<sup>th</sup> ed. Prentice-Hall.
11. Agarwal O. P (2014) *Organic Chemistry: Natural Products*. Krishan Prakashan.

<b>Course Code: PHARM-3608</b>		
<b>Course Title: Medicinal Chemistry-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To practically know about synthesis of drug and drug intermediates and in silico structure modeling.

**Course Outcomes:** At the end of the course, the student will be able to:

- Synthesize drug such as isoniazide, coumarin, cinnamic acid.
- Learn chemical structure drawing and modeling using software.

**Experiments:**

1. Synthesis of following drugs and drug intermediates:
  - a) Meta nitro-benzaldehyde
  - b) Isoniazide
  - c) Coumarin

2. Synthesis of following drugs and drug intermediates:
  - a) Ethyl para hydroxy-benzoate
  - b) Para amino phenol
  - c) Methyl salicylate
  - d) Cinnamic acid
3. Chemical structure drawing using software (ChemDraw, UltraChem).
4. *In silico* structure modeling of different drug molecules.

<b>Course Code: PHARM-3609</b>		
<b>Course Title: Pharmaceutical Analysis-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To learn different chemical and physical techniques used for the identification and estimation or standardization of drugs by UV spectrophotometric, electrochemical and chromatographic analysis.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Learn principle and utility of various analytical instruments like UV, TLC and HPLC.
- Acquire skills in selecting the suitable techniques for analysis of drugs and pharmaceuticals.
- Expand theoretical knowledge on various instrumental techniques available for analysis of organic substances.

#### **Section-A (Mid-term: 30 Marks)**

1. **Visible and Ultraviolet Spectrophotometry:** Introduction, electromagnetic radiation, units, electromagnetic spectra and absorption of radiation, Lambert's and Beer's Laws, Deviation from Lambert-Beer's law, Instrumentation, colorometry, chromophores and auxochromes, analysis of mixtures, absorption and intensity shifts, applications of ultraviolet and visible Spectroscopy in quantitative analysis of drugs.
2. **Electrogravimetric Analysis:** Theory of electroanalysis, polarization, decomposition, potential and over voltage electrolytic determination at constant current and with controlled potential at the cathode.

#### **Section-B (Final Exam: 50 Marks)**

##### **Group-A (20 Marks)**

3. **Polarographic Analysis:** Theory and principle, mass transfer processes, current-voltage relationship, factor affecting diffusion current, maxima, oxygen wave, measurement of diffusion current, application of polarography.
4. **Amperometry:** Introduction, theory and principle, instrumentation, titration curves, amperometric titration using one and two electrode; application of amperometric titration.

##### **Group-B (30 Marks)**

5. **Conductometry:** Apparatus, measurements, experimental details of conductometric titration and applications.
6. **Potentiometry:** Introduction, theory and principle, electrochemical cells and half cells, classification of cell, electrodes, potentiometer, measurement of potential, titration curves, application of potentiometric titration.
7. **Chromatography:**
  - a) **Thin Layer Chromatography (TLC):** Introduction, principles, theoretical consideration of TLC, high-performance thin-layer chromatography (HPTLC), analytical applications of TLC.

**b) High Performance Liquid Chromatography (HPLC):** Introduction, column and the solvent, column technology, detectors, analytical applications of HPLC.

**Recommended Books:**

1. Chatten, L.G. (2010) *Pharmaceutical Chemistry*, Volume 1 and 2. Merce Dekker/CBS Publishers.
2. Watson, D.G (2016) *Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
3. Field L.D, Sternhell S, Kalman J.R. () *Organic Structure from Spectra*. Wiley.
4. Pavia D. L, et.al (2015) *Introduction to Spectroscopy*, 5<sup>th</sup> ed. Cengage learning.
5. Fleming I and Williams D.H (2007), *Spectroscopic Methods in Organic Chemistry*, 6<sup>th</sup> ed. McGraw-Hill.
6. Jeffery, G.H, et.al (1989) *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> ed. Pearson.
7. Sharma, Y.R (2007), *Elementary Organic Spectroscopy*, 4<sup>th</sup> ed. S.Chand and Company.
8. Sethi, P.D (2013) *HPTLC: Quantitative Analysis of Pharmaceutical Formulations*, Vol 1,2,3. CBS.
9. Willard et.al, (1989) *Instrumental Methods of Analysis*, 7<sup>th</sup> ed.
10. Siddiqui, A.M (2013) *Practical Pharmaceutical Chemistry*. CBS Publishers.
11. WHO (1986) *Basic Tests of Pharmaceuticals*. World Health Organization.

<b>Course Code: PHARM-3610</b>		
<b>Course Title: Pharmaceutical Analysis-II Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To know techniques for the assay of pharmaceutical products using titration, iodometric, TLC and UV spectroscopic methods.

**Course Outcomes:** At the end of the course, the student will be able to:

- Familiarize with assay techniques like titration, TLC, UV spectroscopic analysis.
- Determine potency of different pharmaceutical active ingredients.
- Interpret absorption spectra, IR spectra.

**Experiments:**

1. Determination of Fe (II) ion in Mohr's salt solution by the titration with dilute  $\text{KMnO}_4$  solution.
2. Analysis of Cu (II) solution iodometrically.
3. Determination of ampicillin by iodometric method.
4. Estimation of ampicillin by UV spectroscopic method.
5. Preparation of TLC Plate.
6. Separation of organic compound by using TLC.
7. Interpretation of given IR spectra.
8. Determination of effect of solvents on the absorption spectrum of phenol.
9. Determination of effect of pH on the absorption spectrum of sulphanilamide.
10. Determination of purity of organic compound using TLC.
11. Assay of potency of diclofenac sodium tablet by UV spectrometry using standard curve.

<b>Course Code: PHARM-3611</b>		
<b>Course Title: Pharmaceutical Engineering-I</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To learn about the essential unit operations and equipment used in drying, filtration, centrifugation, distillation and sterilization process during preparation of different pharmaceutical dosage forms.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand various unit operations used in pharmaceutical industries.
- Know basic principles, operating processes and uses of different equipment.
- Choose appropriate equipment needed for the intended purposes.

### Section-A (Mid-term: 30 Marks)

- 1. Evaporation:** Definition, factors affecting evaporation, classification of evaporators; Different evaporators: principle, construction, advantages and disadvantages.
- 2. Drying:** Definition, importance of drying, theory and fundamental concepts, periods of drying, equilibrium moisture content (EMC), measurement of EMC, loss on drying (LOD), moisture contents, modes of heat transfer. Types of dryer: static, moving, fluidized and pneumatic dryer; different drying equipments (constructions, operations, merits, demerits, applications): tray dryer, pneumatic conveying dryer, tunnel dryer, fluidized bed dryer (FBD), spray dryer, microwave dryer, pan dryer, rotary vacuum drum dryer and freeze dryer; selection of drying equipment, factors affecting drying process.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Filtration:** Definition of filtration and clarification, applications of filtration, factors affecting the filtration rate, mechanism of filtration, theory of filtration, classification of filters, filter media, filter aids, types of filtration. Different filtration equipments (constructions, operations, merits and demerits): gravity filter, meta filter, plate and frame filter press (recessed plate filter press, vertical pressure leaf filter, horizontal plate filter), bag filters, rotary vacuum drum filter, cartridge filter, membrane filter; selection of filtration equipments, integrating testing of filter media (bubble point test, diffusion test, pressure hold testing).
- 4. Centrifuges:** Definition, process, applications and general principles/theory of centrifugation. Centrifugal force and centrifugal effect, materials of construction, critical speed. Classification of centrifuges; advantages, disadvantages and applications of different sedimentation centrifuges (non-perforated basket centrifuge, continuous horizontal centrifuge, super centrifuge, De Laval Clarifier) and filtration centrifuges (perforated basket centrifuge); centrifuge auxiliaries, selection of centrifugal separators.

#### Group-B (30 Marks)

- 5. Distillation:** Theory, general equipment of distillation; classification of distillation methods: flash distillation, fractional distillation, azeotropic and extractive distillation, steam distillation, molecular distillation, destructive distillation etc.
- 6. Sterilization:** Principle of sterilization; advantages, disadvantages and application of sterilization; classifications of sterilizer, factors affecting sterilization, sterilization by heat, gas, radiation and filtration; aseptic technique, evaluation, types of media used in sterility testing, sterility testing (filtration method, LAL/endotoxin test).

#### Recommended Books:

1. Subrahmanyam, C.V.S and Setty, J.T (2007) *Pharmaceutical Engineering: Principles and Practice*, New Age.
2. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
3. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
4. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
5. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
6. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
7. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
8. Dittert, L.W et.al (1975) *Sprowls' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: PHARM-3613</b>		
<b>Course Title: Oral Assessment-III</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 00</b>	<b>Total Hours: 00</b>

**Course Objectives:**

- To ensure comprehension of the topics covered in class and in the reports.
- To improve students' presentation and communication skills.
- To preparing students for the types of oral assignments required in future linguistic course.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain deeper insights on the topics covered courses.
- Enhance students' self-confidence for the future viva-voce.

**Course Contents:** Previous courses of this syllabus, basic knowledge and miscellaneous.

<b>Course Code: URED-3604</b>		
<b>Course Title: Life and Teachings of the Prophet Muhammad (SAAS)</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** This course is designed:

- To help the students to develop an in-depth study for clear understanding of the last Prophet's life, mission and teachings.
- To show that the Prophet Muhammad (SAAS) is only ideal mentor to follow by the entire humanity.
- To familiarize the students with the exalted characters, manners, habits and behaviors of our beloved Prophet (SAAS) in order to emulate it in their practical life.

**Course Outcomes:** After completion of this course:

- The students will have proper knowledge regarding the life and times of Prophet Muhammad (SAAS).
- They will be able to identify the Prophet (SAAS) as the only ideal mentor to follow.
- They will be able to lead their life according to the exalted characters, manners, habits and behaviors of our beloved Prophet (SAAS).

**Section-A (Midterm Exam: 30 Marks)**

- 1. An introduction to *Siratunnabi* (SAAS):** A comprehensive view, *Sirah* and its literally and technical meaning, Selection of Arabia as the birthplace of the Final Prophet (SAAS), Socio-Political, Religious condition of pre-Islamic Arabia: an Overview.
- 2. Early life of Prophet (SAAS):** Birth and Childhood, Business trip to Syria with his uncle *Abu Talib*, Battle of *Fujjar* and formation of *Hilful-Fudul*, Contribution of Mohammad (SAAS) in the business of Khadijah, Marriage with Khadijah, Rebuilding of *Al-Ka'bah*, Search for the truth and receiving the truth.
- 3. Beginning of Islamic Movement at *Makkah*:** (From first revelation to the emigration to Abyssinia): Prophethood, First revelation and its impact.  
Propagation of Islam Begins in secret, The early Muslims, End of the First Phase.  
Islamic Movement becomes public, The Prophet on the Mount of *Safa*.  
Oppositions from the Quraysh begin, Qur'anic approach towards Quraysh Oppositions.  
Migration to Abyssinia.

### Section-B (Final Exam: 50 Marks)

4. Prophet (SAAS) at *Makkah*: (From emigration to Abyssinia to the migration to *Madinah*)- Boycott and Confinement of the Prophet (SAAS) and Banu Hashim by the Quraysh, The year of sorrow.
5. *Ta'if*- the most difficult day, *Mi'raj* of the Prophet. Covenants of *Al-'Aqabah*. *Hijrah* of the Prophet (SAAS).
6. The Prophet (SAAS) at *Madinah*: (From migration to *Hudaybiyah*) Construction of the Mosque, The Charter of *Madinah*, Important Battles till the agreement of *Hudaybiyah*- The Battle of *Badr*, The Battle of *Uhud*, Battle of *Ahzab*, Campaigns against the Jews of *Madinah*, *Hudaybiyah* Agreement.
7. Letters of the Prophet (SAAS) to the kings beyond Arabia, Battle of *Muta*, Battle of *Hunayun*, The conquest of *Makkah*.
8. The Farewell Pilgrimage, The Farewell Address of the Prophet (SAAS) and its lessons, Departure of the Prophet (SAAS), Contributions of the Prophet (SAAS) as a reformer and as a nation builder and as an Ideal for the all.

#### Recommended Books:

1. Nadwi, Saiyid Sulaiman, *Muhammad The Ideal Prophet: A Historical, Practical, Perfect Model for Humanity*. Translated by Mohiuddin Ahmad. Islamic Book Trust K.L.N.D.
2. Guillaume, Alfred. *The Life of Muhammad: A Translation of Ibn Ishaq's Sirat Rasul Allah*. London: Oxford University Press, 1955.
3. Lings, Martin. *Muhammad: his life based on the earliest sources*. New York: Inner Traditions International, 1983.
4. Nasr, Seyyed Hossein, *Muhammad: Man of God*. Chicago, IL: Kazi Publ., 1995.
5. Ramadan, Tariq. *In the Footsteps of the Prophet: Lessons from the Life of Muhammad*. New York: Oxford University Press, 2009.
6. Watt, William Montgomery. *Muhammad: Prophet and Statesman*. London: Oxford University Press, 1961.

## Seventh Semester

<b>Course Code: PHARM-4701</b>		
<b>Course Title: Pharmaceutical Technology-III</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries on formulation, manufacturing evaluation and packaging of SRDF, aerosol, parenteral and ophthalmic products as well as operation of clean rooms.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand the need, formulation aspects, design and evaluation of various customized, sustained and controlled release dosage forms.
- Take measures to control contamination of production as well as other areas.
- Understand the problems and their remedies of different formulations such as SRDF, injection and aerosols.
- Choice appropriate mode of packaging of different dosage forms.

### **Section-A (Mid-term: 30 Marks)**

- 1. Compaction and Compression of Powder:** Physics of tablet compression, different stages of tablet compression, effect of compression force on tablet properties, strength of tablet, factors affecting the strength of tablet, mechanism of bonding to tablets, problems associated with large scale manufacturing of tablet.
- 2. Sustained Release Drug Delivery Systems:** Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 3. Aerosol Science and Technology:** Definition and classifications of aerosols, advantages and disadvantages of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, systems of aerosol, container, valves and actuators for aerosols, manufacturing of aerosols, testing and quality assurance of aerosols.
- 4. Parenteral and Ophthalmic Products:** Definition and classification of parenteral products, formulation considerations, vehicles and additives, isotonicity, containers, manufacturing consideration, environment, manufacturing techniques, raw materials and machines, quality control of parenteral products, anatomy of eye, absorption of drugs in the eye, classification of ophthalmic products, formulation, vehicles and additives, manufacturing consideration, environment, manufacturing techniques, quality control of ophthalmic products.

#### **Group-B (30 Marks)**

- 5. Design and Operation of Clean Rooms:** Source of contamination, classification of clean rooms, air flow systems conventional flow, unidirectional flow, laminar air flow units, air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction and use, personnel, protective clothing, cleaning and disinfection, commissioning tests of clean and aseptic rooms, routine monitoring tests, the operation of clean and aseptic rooms, key factors in clean room operations.

**6. Packaging Technology:** Purpose of packaging, properties of packaging materials, factors influencing choice of package, advantages and disadvantages of different packaging materials, glass and glass containers, metal and metal containers, plastic and plastic containers, films foils and laminates, rubber based materials, closures, tamper resistant packaging, testing and quality assurance of packaging materials, different packaging machines and accessories, organization of packaging line and labeling.

**Recommended Books:**

1. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
2. Ansel, H.C and Allen, L.V. (2003) *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems*, 10<sup>th</sup> ed. Lippincott Williams and Wilkins.
3. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
4. Carter, S. J (2005), *Cooper and Gunn's Tutorial Pharmacy*, CBS Publishers and Distributors.
5. Gupta, A.K (2004), *Introduction to Pharmaceutics*, Vol I and II, 3<sup>rd</sup> ed. CBS Publishers.
6. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
7. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
8. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
9. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
10. Sheskey, P.J, et.al (2017) *Handbook of Pharmaceutical Excipients*, 8<sup>th</sup> ed. Pharmaceutical Press.
11. Dittert, L.W et.al (1975) *Sprolows' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: PHARM-4702</b>		
<b>Course Title: Pharmaceutical Technology-III Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gather practical knowledge about formulation and packaging of various dosage forms and studies of the of formulation problems of injection, suppository, patch and SRDF.

**Course Outcomes:** At the end of the course, the student will be able to:

- Prepare injection, suppository, transdermal patch.
- Identify packaging problems of tablets/capsules.
- Evaluate different dosage forms.

**Experiments:**

1. Preparation of suppositories.
2. Preparation of betamethasone ophthalmic ointment.
3. Preparation of water for injection.
4. Preparation of injection of procaine and adrenaline.
5. Preparation of injection of procaine with benzylpenicillin.
6. Preparation of dextrose injection.
7. Preparation of transdermal patch.
8. Studies on the of formulation problems of vitamins with minerals.
9. Formulation of SRDF.
10. Preparation of ringer solution.
11. Leakage test of packaging of tablets/capsules.
12. Leakage test of ampoules.

<b>Course Code: PHARM-4703</b>		
<b>Course Title: Pharmaceutical Quality Assurance</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide a wide range of knowledge of quality assurance guidance on Good Manufacturing Practice (GMP), quality system, good documentation practices, regulatory compliance and in all areas that impact drug quality.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Guide good manufacturing practice in pharmaceutical industry.
- Set quality specifications of raw materials, packaging materials, intermediate and finished products.
- Understand quality management system and handle risk factors that affect quality of drugs.
- Familiar with rules and regulations of national and international drug regulatory bodies.

### **Section-A (Mid-term: 30 Marks)**

- 1. Introduction:** Criteria for quality, extrinsic and intrinsic quality, sources of quality variation, control of quality variation, reasons for substandard drugs. Basic concept and history of QA, functions of pharmaceutical quality assurance and quality control; basic principles of GMP and cGMP.
- 2. Material Specifications and Management:**
  - a) Material Specifications:** Raw materials, packaging materials, intermediate products, bulk products and finished products specifications.
  - b) Material Management:** Raw material controls, weighing control, packaging material controls, bulk and intermediate product controls, in process control (IPC), packaging controls, reagent and culture media control, waste materials control.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

- 3. Batch Documentation and Records:** Objectives, criteria of documentation; starting materials records, batch/bulk manufacturing records (BMR), IPC records, QC test records, batch packaging records (BPR), final pack test records, standard operating procedures (SOP), batch deviation, change control, reference standard, site master file (SMF), and typical formats of different documents.
- 4. Recovery Control:** Product residue, reprocessing/reworking, repacking, returned goods, market returns, and batch identity; rejected materials control.
- 5. Environmental Protection:** Source of contaminations, particulate contamination, chemical contamination (primary and cross-contamination), microbial contamination, campaign manufacturing; Environmental monitoring: control limits, techniques for environmental monitoring, environmental protection and procedures.

#### **Group-B (30 Marks)**

- 6. Quality Management:** Concept, objectives, applications; Quality management system (QMS): corrective action and preventive action (CAPA); Internal quality audit; Auditing of suppliers; Market complaints; Product recall; Quality management considerations, quality motivation; Total quality management (TQM).
- 7. Regulatory Controls:** Drug Administration of Bangladesh, International Standard Organization (ISO) policies and concept for quality in pharmaceutical industries; Basic concept of international drug regulatory authority (FDA, MHRA, TGA etc).

**Recommended Books:**

1. Potdar, M. A. (2007) *Pharmaceutical Quality Assurance*, 2<sup>nd</sup> ed. Nirali Prakashan.
2. Khan, S. N. *Assurance of Quality Pharmaceuticals*, Signet Press Chittagong.
3. *Quality Assurance of Pharmaceuticals*, Vol. 1 and 2, 2<sup>nd</sup> ed. World Health Organization.
4. Gee, A. (2009) *cGMP Facilities and Manufacturing, Cell Therapy*. 7<sup>th</sup> ed.
5. Kume, H. (1987), *Statistical Methods for Quality Improvement*, 1<sup>st</sup> ed. Productivity Press.
6. Kume, H. (1899) *Management by Quality*. Productivity Press.
7. ISO 9000 *Quality management*. (2009), [www.iso.org/news/2009](http://www.iso.org/news/2009).

<b>Course Code: PHARM-4705</b>		
<b>Course Title: Pharmacology-III</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about pharmacological properties of mechanism of action, adverse effects, toxicity and dosage of CNS acting, chemotherapeutic agents and antidiabetic drugs. The students are able to know the biological changes that result from repeated drug use, tolerance, addiction and adverse effects.

**Course Outcomes:** After completion of the course, the student will be able to:

- Understand the pharmacological actions and profile of different categories of drugs.
- Know pathophysiology of some diseases and their treatment strategies.
- Apply basic pharmacological knowledge in the rationale usage of CNS acting drugs.

### Section-A (Mid-term: 30 Marks)

1. **Antiepileptic Drugs:** Types of seizures; Antiepileptic drugs: Phenytoin, primidone, phenobarbitone, mephobarbitone, carbamazepine, valproic acid, lamotrigine, vegabatin, benzodiazepines, trimethadone, gabapentin.
2. **CNS Stimulant Drugs:** Psychomotor stimulants (methylxanthines, cocaine, amphetamine, nicotine, ephedrine etc) and hallucinogens (lysergic acid diethylamide).
3. **Sedative and Hypnotic Drugs:** Benzodiazepines and barbiturates, non-barbiturate sedatives.
4. **Anti-asthmatic Drugs:** Goals of therapy, role of inflammation in asthma, drugs for asthma, drugs for chronic obstructive pulmonary diseases (COPD).

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

5. **Psychotropic and Antidepressant Drugs:** Selective serotonin reuptake inhibitors (SSRIs), atypical antidepressant, tricyclic antidepressant, monoamine oxidase inhibitors (MAOIs).
6. **Antidiabetic Agents:** Types, causes, complications and treatment of diabetes. Hypoglycemia- causes and treatment; Relationship between stroke and diabetes, causes of stroke. Antihyperglycemic agents: Insulin, sulfonylureas, biguanides, thiazolidinediones/glitazones,  $\alpha$ -glycosidase inhibitors, GI hormones. Insulin resistance, management of diabetes. Glucagon structure, mechanism, uses.

#### Group-B (30 Marks)

7. **Antineoplastic/Anticancer Drugs:** The cell cycle, principles of cancer chemotherapy; Chemotherapeutic agents: Alkylating agents, antimetabolites, vinca alkaloids, Taxanes antibiotics, cisplatin, carboplatin, etoposide.
8. **Anti-hyperlipidemic Drugs:** Regulation of plasma lipoproteins; Antihyperlipidemic drugs: HMG-CoA reductase inhibitors, fibrates, niacin, bile acid sequestrants etc.

**9. Antimalarial, anthelmintic and antiprotozoal drugs:** Classification, mechanism of action, adverse effects, clinical uses, dosages etc.

**10. Drugs Affecting Uterine Contraction:** Oxytocin, prostaglandin, ergot alkaloid.

**11. Hormone Therapy:** Adenohypophyseal and adrenocorticosteroid hormones.

**Recommended Books:**

1. Rang, H.P, Dale, M.M, et.al (2015) *Rang and Dale's Pharmacology*, 8<sup>th</sup> ed. Churchill Livingstone.
2. Katzung, B.G, et.al (2009) *Basic and Clinical Pharmacology*, 11<sup>th</sup> ed. Lange/McGraw-Hill.
3. Brunton, L.L, et.al (2006) *Goodman and Gillman's Pharmacological Basis of Therapeutics*, 11<sup>th</sup> ed. McGraw-Hill.
4. Satosker, R.S, et.al (2005) *Pharmacology and Pharmacotherapeutics*, 19<sup>th</sup> ed. Popular/ Elsevier India.
5. Finkel, R, et.al (2009) *Pharmacology*, 4<sup>th</sup> ed (Lippincott's Illustrated Reviews). Lippincott/LWW.
6. Tr ipathi, K.D (2013) *Essentials of Medical Pharmacology*, 7<sup>th</sup> ed. Jaypee Brothers.
7. Bennett, P.N and Brown M.J (2003) *Clinical Pharmacology*, 9<sup>th</sup> ed. Churchill Livingstone.
8. Misbahuddin, M and Islam, M.R (1998) *General Principle of Pharmacology*, 4<sup>th</sup> ed. Books and Allied.
9. Herfindal, E.T and Hirschman, J.L (1992) *Clinical Pharmacy and Therapeutics*, 4<sup>th</sup> ed. Williams and Wilkins.
10. Luellman, H, Mohr, K, Hein, L (2017) *Color Atlas of Pharmacology*, 5<sup>th</sup> ed. Thieme.

<b>Course Code: PHARM-4706</b>		
<b>Course Title: Pharmacology-III Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To investigate various pharmacological actions of pharmaceutical products on mice/rats model and to measure glucose level and drug concentrations from human blood samples.

**Course Outcomes:** By the end of the course, the student will be able to:

- Observe activity of ANS and CNS acting drugs on animal model.
- Estimate cholesterol and plasma protein by chemical and enzymatic methods.

**Experiments:**

1. Study of mydriatic and myotic effect on rabbit eye (e.g. pilocarpine, atropine).
2. Biological assay of histamine and insulin.
3. Estimation of cholesterol in human blood by chemical method.
4. Estimation of plasma protein by enzymatic method.
5. Toxicity test of the drugs like phenobarbitone, some antineoplastic drugs, pilocarpine.
6. Effect of digitalis, adrenaline, noradrenaline, isoprenaline on toad's heart.
7. Sedative and hypnotic activity of diazepam on mice/rats.

<b>Course Code: PHARM-4707</b>		
<b>Course Title: Pharmaceutical Regulatory Affairs</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To know about the concepts, approval process, format and registration process of pharmaceuticals for human use at home and abroad; drug acts and ordinances, and other rules and regulations.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand the national and international law, act, policy, rules and regulations of drug.
- Know pharmacist's role in marketing of drugs.
- Familiar with regulatory guidance and guidelines for approval process of drug.
- Aware punishment of violations of the drug laws.

**Section-A (Mid-term: 30 Marks)**

1. Approval process, format and registration of pharmaceuticals in Bangladesh.

2. Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons: The Drug Act 1940, The Poisons Act 1919 and related amendments, The Drug Ordinance 1982, The Drug Policy 1982, The Drug (control) Ordinance 1982, The Narcotics (control) Act 1990, The Drug Policy 2006.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

3. Rules and regulations for controlling poisons and narcotic materials in Bangladesh.
4. Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976).

#### Group-B (30 Marks)

5. Control of drug advertisements and prices, patented and trade market medicine, proprietary medicine, regulation of cosmetics and poison control.
6. Drug Authority of Bangladesh: Functions and activities of Directorate of Drug registration methods in Bangladesh, Technical committee and Drug Control committee (DCC).

#### Recommended Books:

1. Pharmacy Ordinance, 1976. Ministry of Law and Parliamentary Affairs, Government of Bangladesh.
2. The Drugs (control) Ordinance, 1982, Ministry of Law and Land Reforms, Government of Bangladesh.
3. Drug Policy of Bangladesh, Ministry of Health and Population Control, Health Division, Government of Bangladesh.
4. Amran, S. *Pharmaceutical Regulatory Affairs and Standards*.
5. Mithal, B.M. *A Textbook of Forensic Pharmacy*.
6. Pharmacist's Code of Ethics, Pharmacy Council of Bangladesh.
7. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.

<b>Course Code: PHARM-4709</b>		
<b>Course Title: Pharmaceutical Analysis-III</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To know about different chemical and physical techniques used for the identification and estimation or standardization of drugs by using different chemical methods of analysis in the pharmaceutical industry using IR, UV, NMR, GC etc.

**Course Outcomes:** At the end of the course, the student will be able to:

- Learn principle and utility of various analytical instruments like IR, NMR and GC.
- Acquire skills in selecting the suitable techniques for analysis of drugs.
- Know process and statistical interpretation of microbiological assay of antibiotics.

### Section-A (Mid-term: 30 Marks)

1. **Infrared Spectrometry:** Introduction, principle of IR spectroscopy, instrumentation, molecular vibration, vibrational frequency, degree of freedom, finger print region, analysis of IR spectra, application of IR spectroscopy.
2. **Mass Spectroscopy:** Basic principle and theory, instrumentation, determination of molecular mass, ionization technique, , rearrangement and fragmentation process, mass analyzer, analysis of spectra, applications of mass spectroscopy.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

3. **Atomic Absorption Spectroscopy:** Theory, instrumentation, factors affect atomization and application of AAS.

- 4. X-ray Crystallography:** X-ray and diffraction of X-ray by crystals, Bragg's law, powder diffraction pattern, methods of measurement and analytical application of x-ray diffraction.

### Group-B (30 Marks)

**5. Nuclear Magnetic Resonance Spectroscopy:**

a) **<sup>1</sup>H NMR 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.

b) **<sup>13</sup>C NMR spectroscopy:** Introduction, principle, chemical shift, spin-spin coupling, applications.

- 6. Microbiological Assay of Antibiotics:** Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors affecting diffusion assay, Dose response curve, large plate assay using Latin square design, statistical interpretation of microbiological assay methods.

**Recommended Books:**

1. Chatten, L.G. (2010) *Pharmaceutical Chemistry*, Volume 1 and 2. MerceL Dekker/CBS Publishers.
2. Watson, D.G (2016) *Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
3. Field L.D, Sternhell S, Kalman J.R. *Organic Structure from Spectra*. Wiley.
4. Pavia D. L, et.al (2015) *Introduction to Spectroscopy*, 5<sup>th</sup> ed. Cengage learning.
5. Fleming I and Williams D.H (2007), *Spectroscopic Methods in Organic Chemistry*, 6<sup>th</sup> ed. McGraw-Hill.
6. Jeffery, G.H, et.al (1989) *Vogel's Textbook of Quantitative Chemical Analysis*, 5<sup>th</sup> ed. Pearson.
7. Sharma, Y.R (2007), *Elementary Organic Spectroscopy*, 4<sup>th</sup> ed. S.Chand and Company.
8. Willard et.al, (1989) *Instrumental Methods of Analysis*, 7<sup>th</sup> ed.
9. Siddiqui, A.M (2013) *Practical Pharmaceutical Chemistry*. CBS Publishers.
10. WHO (1986) *Basic Tests of Pharmaceuticals*. World Health Organization.

<b>Course Code: PHARM-4711</b>		
<b>Course Title: Pharmaceutical Engineering-II</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To gain in-depth knowledge about the essential unit operations and equipment used in mixing as well as milling process during preparation of solid, liquid and semi-solid dosage forms; to know HVAC system, water treatment system and layout of a pharmaceutical manufacturing plant.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand principles and methodology of various processes involved in a pharmaceutical industry.
- Familiar with the equipment used in mixing as well as milling process and their uses.
- Appreciate and comprehend significance of pharmaceutical lay out plan and design.

### Section-A (Mid-term: 30 Marks)

**1. HVAC (Heating, Ventilation, and Air Conditioning):**

a) **Humidity control:** Terminology (psychometry, 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.

- b) Air conditioning:** Definition, importance, pharmaceutical application, differences between air conditioner and air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air conditioned room, pharmaceuticals needing air conditioning.
- c) Refrigeration:** Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage.
- d) Ventilation:** Definition, pharmaceutical application and design.
- 2. Water Treatment Plant (WTP) and Effluent Treatment Plant (EPT):** Operations, techniques, applications etc.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. 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.
- 4. Layout Plan of Pharmaceutical Manufacturing Plant:** Guidelines for selecting new plant sites, pharmaceutical lay out plan and design, criteria for production facilities.

#### Group-B (30 Marks)

- 5. Solid-Solid Mixing:** Importance, fundamentals, batch homogeneity, types of solids-mixing machines: (mixing mechanisms and operations) double cone, twin shell, horizontal drum, double- cone revolving around long axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor, performance, characteristics, selection of machines.
- 6. Paste Mixing:** Definition, importance, simple blending, dispersion operations and general equipment design. Standard types of equipment and operations, change-can mixer, change-can mixer with planetary motion, change-can mixer with rotating turntable, troy angular mixer, duplex mixer, stationary -tank mixer, kneader, mullers, three-roll mill, selection of process and mixer.
- 7. Liquid Mixing:** Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, fiat -blade and curved blade turbines, spiral turbines, paddles, gate impellers, anchor impellers, different fixed-mounted and portable positions, shaft lengths, baffled and unbaffled tanks, vortex formation and its control, selection of impeller.

#### Recommended Books:

1. Subrahmanyam, C.V.S and Setty, J.T (2007) *Pharmaceutical Engineering: Principles and Practice*, New Age.
2. Aulton, M.E and Taylor, K. (2013) *Aulton's Pharmaceuticals: The Design and Manufacture of Medicines*, 4<sup>th</sup> ed. Churchill Livingstone/Elsevier.
3. Allen, L.V. (editor) (2005) *Remington: The Science and Practice of Pharmacy*, 21<sup>st</sup> ed. Lippincott.
4. Martin, E.W (1971) *Dispensing of Medication (Formerly- Husa's Pharmaceutical Dispensing)*, 7<sup>th</sup> ed. Marck.
5. Lachman, L. and Lieberman, H.A (1991) *The Theory and Practice of Industrial Pharmacy*, 3<sup>rd</sup> ed. Lea and Febiger.
6. Fishburn, A.G (1965) *An Introduction to Pharmaceutical Formulations*. Pergamon.
7. Martindale, W. and Reynolds, J.E.F (1996) *Martindale: The Complete Drug Reference (Formerly- The Extra Pharmacopeia)*, 31<sup>st</sup> ed. Pharmaceutical Press.
8. Dittert, L.W et.al (1975) *Sprowls' American Pharmacy*, 7<sup>th</sup> ed. Lippincott.

<b>Course Code: URIH-4701</b>		
<b>Course Title: A Survey of Islamic History and Culture</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** The objective of this study is to enrich the learners with the glorious history of four pious *Khalifah* of Islam and their remarkable contributions towards the development of just administration, advancement of civilization and education and their great services towards humanity at large. This course also aims at making the students acquainted with the glorious contribution of the Muslims towards the world civilization during the *Umayyads* and *Abbasids* *Khilafah*. The contributions include the advancement of administration, society, civilization, different branches of science such as geography, mathematics, history, medical science, philosophy etc.

**Course Outcomes:** With the study of this course, the learners will be able to explore the glorious history of early Islamic society and state, particularly of four pious *Khalifah* and their successors. The learners will also have the idea about the Muslim contributions towards the different branches of world civilization. This study will also help the students to realize the historical processes of development of Muslim society in early time and to make a comparison with the present society. It will enable the learners to appreciate various good practices and cultures which will in turn be resulted in becoming a responsible citizen.

#### **Section A (Midterm Examination: 30 Marks)**

- 1. *Khilafah*:** Definition, Origin and Development of *Khilafah*, Difference between *Khilafah* in general sense and *Khilafah 'Ala-minhaj al- Nabuwwah*, election to the office of the *Khilafah*, *Khilafah* vs *Mulukiyyah*, End of *Khilafah*, duties and responsibilities of a *Khalifah*.
- 2. Introduction to the Four Pious *Khalifah*:** Character and achievements of the Pious Caliphs, an overall portrayal of four pious *Khalifah*: Abu Bakr (R) -the savior of Islam, Umar (R) - the model of administration and great conqueror of Islamic empire, Conquest during his *Khilafah*, Usman (R) - compilation of Qur'an and his other achievements, Causes of revolt, assassination of Usman (R) and its effects on the history, Ali (R) - civil wars during his time and his other achievements.
- 3. Administration under the Four Pious *Khalifah*:** The *Shura*, Civil Administration, Sources of Revenue, *Bait-al-Mal*, judicial Administration, Police-Prison, Religious Administration and Military Administration.

#### **Section B (Final Examination: 50 Marks)**

- 4. The Umayyad *Khilafah* (661 A.D-750 A.D):** A brief discussion on Umayyad *Khilafah*, Administrative reforms of Abdul Malik *bin* Marwan, Conquest and expansion of Islamic empire under Walid bin Abdul Malik, Umar bin Abdul Aziz and his Administration Policies.
- 5. The Umayyad Administration:** Central and Provincial Administration, Social Condition. Umayyah's contribution towards the development of civilization and education, Fall of the Umayyads. An overall portrayal of Umayyad *Khilafah*.
- 6. The Abbasid *Khilafah* (750 A.D-1258 A.D):** Golden Prime of the Abbasids- Abul Abbas as Suffa, Abu Zafar al Mansur, Harun or Rashid, Al Amin and Al Mamun, Abbasid Society, Scientific and Literary development, Education, Development of Art and Architecture, Civil, Military, Judicial and Revenue Administration under the Abbasids. An overall portrayal of Abbasid *Khilafah*.
- 7. The Umayyad *Khilafah* of Spain and the Fatimid *Khilafah* of Egypt.** A brief analysis.
- 8. Society during *Khilafah*:** Rights and Status of women, orphans, disables, non-Muslim citizens in Islamic Society during the period of *Kulafa al- Rashideen*, the Umayyad and Abbasid *Khilafah*.

**9. Muslim contribution to the different fields of world civilization:** Geography, Medicine, Chemistry, Mathematics, Astronomy, Historiography, Art and literature.

**Recommended Books:**

1. P.K. Hitti, *History of the Arabs*, Macmillan edition, 1970, London.
2. S.A.Q. Hussaini, *The Arab Administration*, 1956, Lahore.
3. Syeed Ameer Ali, *A Short History of Saracens*, Macmillan edition, 1916, London.
4. T.I. Arnold, *The Caliphate*, Oxford, 1924, London.
5. Muhammad Ali, *The Early Caliphate*, Cambridge, 1936, London.
6. W. Muir, *Caliphate, Its Rise, Decline and fall*, Edinburg, 1934.
7. B. Lewis, and P.M. Holt (ed.), *Cambridge History of Islam*, 1947.
8. Syeed Ameer Ali, *The Spirit of Islam*, Christophers, 1891, London.
9. Thomas Arnold, *The Legacy of Islam*, Oxford, 1931, London.
10. Joseph Hell, *The Arab Civilization*, W. Heffer and sons, limited, 1926, London.
11. Hamilton Gibb A.R. *Studies on the Civilization of Islam*, Princeton, 1982, London.
12. R. Levy, *The Social Structure of Islam*, Cambridge 1979, London.
13. R.A. Nicholson, *A Literary History of the Arabs*, Cambridge 1930, London.
14. A.M.A. Shushtery, *Outline of the Islamic Culture*, The Bangalore Printing and Publishing Co. Ltd., Bangalore, 1954, India.
15. S.M. Imamuddin, *Arab Muslim Administration*, 1976, Karachi. *Encyclopedia of Islam*.
16. S. Khuda Baksh, *Islamic Civilization* vol 1-2, Idara Islamiyat-e-Diniyat, or Kitab Bhavan, 1984, Delhi.
17. H.K. Sherwani, *Studies in Muslim Political Thought and Administration*, Muhammad Ashraf, 1945, Lahore.
18. M.A. Shabon, *The Abbasid Revolution*, Cambridge, 1970, London.
19. M.A. Shabon, *Islamic History; A New Interpretation*, 1971, London.
20. R.H. Turner, *Science in Medieval Islam: An Illustrated Introduction*. 1995, Austin: University of Texas Press.
21. M. Iqbal, *The Reconstruction of Religious Thought in Islam*. 1986, Institute of Islamic Culture, Lahore.
22. M.N. Roy, *The Historical Role of Islam*, Ajanta Publications, 1981, Delhi.
23. Musa Ansari, *Moddhojoger Muslim Sovvota o Sonskriti*, Bangla Academy, 1999, Dhaka.
24. Board of Researchers, *Scientific Indications in the Holy Quran*, Islamic Foundation Bangladesh, 2004, Dhaka.
25. R.M. Savory, *Introduction to Islamic Civilization*, Cambridge University Press, 1977, London.
26. Franz Rosenthal, *A History of Muslim Historiography*, Leiden, 1952.
27. Cobb S., *Islamic Contributions to Civilization*, Avalon Press, Washington, 1963.
28. Ziauddin Sardar, *Science, Technology and development in the Muslim World*, Croom Helm, 1977, London.
29. M. Akbor Ali, *Bigghane Musalmander Obodan (Muslim Contribution to science)* Volume 1-12, 1936, Dhaka.

## Eighth Semester

<b>Course Code: PHARM-4801</b>		
<b>Course Title: Food Technology, Nutraceuticals and Herbal Medicines</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To learn, identify and describe the functional foods that confer health benefits and whether foods contain health specific bio-actives.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand nutraceutical constituents and their values present in various food products.
- Explain health benefits of functional foods.
- Know physiological and functional basis of various phytochemical compounds of natural and synthetic sources.

### Section-A (Mid-term: 30 Marks)

- 1. Introduction:** Overview of functional foods, nutraceutical, dietary supplements and herbal medicine, their role in health care management.
- 2. Food Components and Nutrition:** Food composition, macronutrients, micronutrients, protein, carbohydrates, fats and oils vitamins, minerals, dietary fibers and fiber-like ingredients, trans fatty acids and omega 3,6,9 fatty acids, sugar and fat substitutes.

### Section-B (Final Exam: 50 Marks)

#### Group-A (20 Marks)

- 3. Food, Nutrition, Health and Diseases:** Relationship of nutrition and health, dietary guidelines/food pyramid, food habit and obesity, effects of trans and omega 3,6,9 fatty acids on health and diseases.
- 4. Nutraceuticals in Herbal Products, Fruits, Vegetables and Grains:** Effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipemic herbs and nutraceuticals.

#### Group-B (30 Marks)

- 5. Food Processing and Food Products Developments:** Food preservation, food irradiation, fermentation, processing of dairy foods, confectionary foods, cereals and grains, beverages, special infant foods and formulas, microorganisms in food, food packaging.
- 6. Quality Assurance of Nutraceuticals, Dietary Supplements and Herbal Products:** GMPs, hazard and risk analysis, quality factors, toxicity analysis, shelf life of nutraceuticals, functional foods and dietary supplements, bioavailability and safety issues of functional foods and nutraceuticals.

#### Recommended Books:

1. Wildman, R.E.C (2006) *Handbook of Nutraceuticals and Functional Foods*, 6<sup>th</sup> ed. CRC Press.
2. Pathak, Y.V (2009) *Handbook of Nutraceuticals*, Volume I and II. CRC Press.
3. Hasler C.M (editor) (2005) *Regulation of Functional Foods and Nutraceuticals: A Global Perspective*. Wiley-Blackwell.
4. Vaclavik, V. and Christian, E.W (2014) *Essentials of Food Science*, 4<sup>th</sup> ed. Springer.
5. Shi, J. (2015) *Functional Food Ingredients and Nutraceuticals: Processing Technologies*, 2<sup>nd</sup> ed. CRC Press.
6. Tull, A. (2002) *Food Technology: An Introduction*. Oxford University Press.
7. DeFelice, S.L (1997) *Nutraceuticals: Developing, Claiming, and Marketing Medical Foods*. Taylor and Francis.
8. Hammer, W,C,K and Dhamija, O.P (1991) *Manuals of Food Quality Control: Food Analysis: Quality, Adulteration and Tests of Identity*. Food and Agriculture Organization.
9. Mathlouthi, M. (1994) *Food Packaging and Preservation*. Springer.

<b>Course Code: PHARM-4803</b>		
<b>Course Title: Pharmaceutical Quality Control and Validation</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To learn, in accordance with the principles of GMP and GLP, the procedure, process, equipment, material, activity or system actually leads to the expected quality results of pharmaceuticals.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Gain skills on sampling process, calibration of analytical tools and stability testing.
- Set of principles intended to assure the quality and integrity of pharmaceuticals.
- Know qualifications and validation protocols of building, equipment, critical systems and different processes.

### **Section-A (Mid-term: 30 Marks)**

1. **Quality Control Overview:** Introduction, general information, significance of quantitative and qualitative analysis in quality control, sampling techniques (n-plan, p-plan, r-plan). Pharmacopoeial tests and specifications, standardization of pharmaceuticals and formulated products, quality control systems for drugs and pharmaceuticals, causes of poor quality.
2. **Stability Testing:** Stability study, methods of stability study, factors of stability, international climate zones and conditions, basic concepts of International Council for Harmonisation (ICH).

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

3. **Good Laboratory Practice (GLP):** History, principles, fundamental considerations, resources of GLP (personnel, materials, reagents, equipment, instruments), rules for performing studies, characterizations, data collection, typical GLP implementation process.
4. **Calibration:** Purposes of calibration, responsibility for calibration; time travel, measurements, records and scheduling of calibration, labeling of calibration tag.

#### **Group-B (30 Marks)**

5. **Validation:** Introduction, concept, scope, importance, limitations, and documentation of validation; **Qualifications of validation:** Design qualification (DQ), Installation qualification (IQ), Operational qualification (OQ), Performance qualification (PQ), and Component qualification (CQ).
  - a) **Validation of Building, Facilities and Equipments:** Process and qualifications.
  - b) **Process Validation:** Prospective validation, concurrent validation, revalidation, retrospective validation.
  - c) **Validation of Analytical Methods:** Accuracy, precision, specificity, limit of detection, limit of qualification, linearity, range, ruggedness, robustness. 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).
  - d) **Cleaning Validation:** Definition, design of a cleaning method, process and factors in cleaning validation, importance of cleaning.
6. **Concept of Statistical Quality Control:** Normal frequency distribution, Q.C charts, binomial distribution, tests of significance, consumer acceptance testing, analysis of variance (ANOVA) and experimental design.

**Recommended Books:**

1. Nash, R.A and Wachter, A.H (2003) *Pharmaceutical Process Validation*, 3<sup>rd</sup> ed. CRC Press.
2. Cooper, M.S (1979) *Quality Control in Pharmaceutical Industry*, Vol. 1-3. Academic Press.
3. WHO (2009). Hand Book: Good Laboratory Practice: Quality practices for regulated non-clinical research and development, 2<sup>nd</sup> ed.
4. Willig, S.H and Stoker, J.R (1997) *Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control from Manufacturer to Consumer*, 4<sup>th</sup> ed. Marcel Dekker.
5. Swartz, M.E and Krull, I.S (1997) Analytical method development and validation. CRC Press.
6. Yoshioka, S. and Stella, V.J (2000) *Stability of Drugs and Dosage Forms*. Springer.
7. Potdar, M. A. (2007) *Pharmaceutical Quality Assurance*, 2<sup>nd</sup> ed. Nirali Prakashan.
8. Khan, S. N. *Assurance of Quality Pharmaceuticals*, Signet Press Chittagong.
9. *Quality Assurance of Pharmaceuticals*, Vol. 1 and 2, 2<sup>nd</sup> ed. World Health Organization.
10. Kume, H. (1987), *Statistical Methods for Quality Improvement*, 1<sup>st</sup> ed. Productivity Press.
11. Kume, H. (1989) *Management by Quality*, Productivity Press.
12. ISO 9000 *Quality management*. (2009), www.iso.org/news/2009.

<b>Course Code: PHARM-4805</b>		
<b>Course Title: Cosmetology</b>		
<b>Credit Hours: 02</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain in-depth knowledge of specific areas, including design, preparation, working procedures, quality assurance and legislation of cosmetic preparations like skin products, hair products and dental products.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Learn specific areas of importance primarily for cosmetic profession.
- Critically examine, analyze and apply the formulation development, manufacturing/production and testing of cosmetic products.
- Identify appropriate cosmetic raw materials and cosmetics compatible with skin.

### **Section-A (Mid-term: 30 Marks)**

1. **The skin:** Introduction, epidermis and keratinizing system, pigmentary system, Langerhans cell, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin.
2. **Skin Creams:** Introduction, classification of skin creams, cold cream, vanishing creams, emollient cream and lotion; formulation and manufacturing.
3. **Hair Products:** Structure of hair follicle; shampoos, hair setting lotions, hair tonic and conditioners, hair colors.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

4. **Shaving Preparations:** Introduction, lather shaving cream, brushes less or non-lathering cream, aerosol shaving foams, after shave preparations.
5. **Deodorants:** Introduction, ingredients, formulation and manufacturing of talcum powder, perfume, etc.

#### **Group-B (30 Marks)**

6. **Dental Products:** Introduction, structure of teeth, dental diseases, ingredients, formulation and manufacturing of toothpastes, tooth powder and mouthwash.
7. **Lip-products:** Introduction, ingredients, formulation and manufacturing of lip stick, Chap Stick etc.

**Recommended Books:**

1. Rieger, M.M (editor) (2000) *Harry's Cosmeticology*, Vol 1 and 2, 8<sup>th</sup> ed. Chemical Publishing Company.

2. Williams, D.F and Schmitt, W.H (1992) *Chemistry and Technology of the Cosmetics and Toiletries Industry*. Springer.
3. Simmons, J.V (1995) *The Science of Cosmetics*, 2<sup>nd</sup> ed. Macmillan.
4. Bennett, R. (2004) *The Science of Beauty Therapy*, 3<sup>rd</sup> ed. Hodder Education.
5. Poucher, W.A (2013) *Perfumes, Cosmetics and Soaps: Modern Cosmetics*, Vol. 1,2,3. Springer.
6. Groom, N. (2012) *The Perfume Handbook*. Springer.
7. Smolinske, S.C (1992) *Handbook of Food, Drug and Cosmetic Excipients*, CRC Press.

<b>Course Code: PHARM-4806</b>		
<b>Course Title: Cosmetology Lab</b>		
<b>Credit Hours: 01</b>	<b>Contact hours per week: 02</b>	<b>Total Hours: 30</b>

**Course Objectives:** To gain practical experience for the preparation and quality control of different cosmetic products.

**Course Outcomes:** At the end of the course, the student will be able to:

- Prepare cream, toothpaste, lotion, gel, face powder and shampoo.
- Evaluate and label the cosmetic products as per cosmetic legislations.

#### **Experiments:**

1. Preparation of cold cream (w/o emulsion).
2. Preparation of vanishing cream (o/w emulsion).
3. Preparation of lather/non-lather shaving cream.
4. Preparation of tooth paste.
5. Preparation of baby lotion.
6. Preparation of cleansing/antidandruff shampoo.
7. Preparation of hair gel.
8. Preparation of face powder.
9. Preparation of hair conditioner.
10. Preparation of lipstick.

<b>Course Code: PHARM-4807</b>		
<b>Course Title: Medicinal Chemistry-III</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To acquire adequate scientific information on structure activity relationship of drugs and to learn techniques used to synthesize, purify, analyze, and screen a numbers of chemical compounds for design and development of new drugs by studying combinatorial chemistry.

**Course Outcomes:** Upon successful completion of the course, the student will be able to:

- Understand relation of different structures to increase potential activity or minimize toxicity of the parent molecules.
- Optimize the structure and functions of medicinal agents by molecular modifications.
- Introduce to drug discovery process by combinatorial synthesis.

#### **Section-A (Mid-term: 30 Marks)**

#### **1. Chemistry, SAR, mode of action and synthesis of the following groups of drugs:**

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

- f) Anticholinergic agents and  
g) Antiadrenergic agents

**Section-B (Final Exam: 50 Marks)**  
**Group-A (20 Marks)**

**2. Receptor Mechanisms of following Drugs:**

- a) Opioid Analgesics                      b) Anti Ulcer agents                      c) Anticancer agents

**3. Synthesis and Applications of Pharmaceutical Drugs:** Paracetamol, aspirin, phenacetin, para-amino benzoic acid (PABA) and sulpha drugs, etc.

**Group-B (30 Marks)**

**4. Combinatorial Chemistry:**

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

**Recommended Books:**

1. Terrett, N.K (1998) *Combinatorial Chemistry*. Oxford University Press.
2. Patrick, G.L. (2006), *An Introduction to Medicinal Chemistry*, 3<sup>rd</sup> ed (1<sup>st</sup> Indian ed). Oxford Univ. Press.
3. Williams, D.A and Lemke, T.L (2002) *Foye's Principles of Medicinal Chemistry*, 5<sup>th</sup> ed. Lippincott.
4. Kar, A. (2007) *Medicinal Chemistry*, 4<sup>th</sup> ed. New Age Publishers.
5. Alagarsamy, V. (2013) *Textbook of Medicinal Chemistry*, Vol I and II, 2<sup>nd</sup> ed. Elsevier India.
6. Abraham, D.J and Rotella, D.P (2010) *Burger's Medicinal Chemistry, Drug Discovery and Development*, Vol 1-8, 7<sup>th</sup> ed. Wiley.
7. Smith, H.J (2005) *Smith and Williams' Introduction to the Principles of Drug Design and Action*, 4<sup>th</sup> ed. CRC Press.
8. King, F.D (2002) *Medicinal Chemistry: Principles and Practice*, 2<sup>nd</sup> ed. Royal Society of Chemistry.
9. Beale, J.M and Block, J.H (2010) *Willson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry*, 12<sup>th</sup> ed. Lippincott Williams and Wilkins.
10. Agarwal O. P (2014) *Organic Chemistry: Natural Products*. Krishan Prakashan.
11. Morrison, R.T and Boyd, R.N (2002) *Organic Chemistry*, 6<sup>th</sup> ed. Prentice-Hall.
12. Joule, J. A, Smith G. F, Mills, K (2010) *Heterocyclic Chemistry*, 5<sup>th</sup> ed. Wiley-Blackwell.

<b>Course Code: PHARM-4809</b>		
<b>Course Title: Clinical Pathology and Toxicology</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** The course is designed to give the student an understanding of the pathogenesis/pathophysiology of the disease states discussed, identify the signs and symptoms characteristic of a given disease state, complications that may arise from drug therapy, and management of poisoning.

**Course Outcomes:** On successful completion of this course, students will be able to:

- Outline principal steps involved in practice of clinical pharmacy.
- Explain rationale for considering the appropriate model in clinical trials.
- Critically review the issues involved in the management of clinical issues.

**Section-A (Mid-term: 30 Marks)**

1. **Introduction:** Clinic, hospital, clinical pharmacy; scope, importance and application of clinical pharmacy, scope of pathology.
2. **Clinical Chemistry and Interpretation of Clinical Laboratory Tests:**
  - a) **Blood Chemistry:** Water, electrolytes (Na, K, Ca etc), acidosis (metabolic and respiratory), alkalosis (metabolic and respiratory), urea, uric acid, BUN, creatinin, SGOT, SGPT, ALT etc.
  - b) **Hematology:** RBC, WBC, platelet, ECG, red cell indices, plasma protein.
  - c) **Urinalysis:** Macroscopic, microscopic, physical chemical test of urine.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

3. **Clinical Interpretation of Pathophysiology of the Diseases:**
  - a) **Infectious Diseases:** AIDS, UTI, tuberculosis, pneumonia, diphtheria, plague, tetanus, giardiasis.
  - b) **Heart Diseases:** Hypertension, congestive heart failure, Ischemia, myocardial infarction, congenital heart disease.
  - c) **Lung Diseases:** Bronchitis, asthma, COPD, pulmonary hypertension.
  - d) **Kidney Diseases:** Renal failures, nephritis, nephrolithiasis/urolithiasis.

#### **Group-B (30 Marks)**

- e) **Endocrine and Exocrine System Diseases:** Pancreatic diseases, diabetes mellitus, Zollinger-Ellison syndrome.
  - f) **Neoplasia:** Characteristics, grading and stages of cancer, metastasis, karyotype changes in tumor, carcinogenic agents and their cellular interaction, oncogenes and cancer, sarcomas.
  - g) **Nutritional Diseases:** Deficiency states of vitamins and minerals.
4. **Toxicology**
    - a) **Introduction:** Definition, general management of poisoning, diagnosis of poisoning, classification of poisons, role of pharmacist in a case of poisoning, obstetric and pediatric considerations in poisoning, role of poison control centers etc.
    - b) **Clinical Signs, Symptoms and Management of Poisoning:** Pesticides, solvents, gases, food toxins, cyanides poison, cosmetics, toxins of animal origin, over-doses of drugs, drug interactions etc.

#### **Recommended Books:**

1. Walker, B.R (2014) *Davidson's Principles and Practice of Medicine*, 22<sup>nd</sup> ed. Churchill Livingstone.
2. Herfindal, E.T, Gourley, D.R, Hart, L.L (1992) *Clinical Pharmacy and Therapeutics*, 5<sup>th</sup> ed. Lippincott.
3. Walker, R and Whittlesea, C (2011) *Clinical Pharmacy and Therapeutics*, 5<sup>th</sup> ed. Churchill Livingstone.
4. Swash, M and Glynn, M (2006) *Hutchison's Clinical Methods*, 22<sup>nd</sup> ed. Saunders.
5. Kumar, V, Abbas, A, Aster, J (2014) *Robbins and Cotran's Pathological Basis of Disease*, 9<sup>th</sup> ed. Saunders.
6. Walter, J.B and Israel, M.S (1989) *General Pathology*, 6<sup>th</sup> ed. Churchill Livingstone.
7. Dhillon, S and Raymond, R (2009) *Pharmacy Case Studies*, 1<sup>st</sup> ed. Pharmaceutical Press.
8. Nand, P and Khar, R.K (2007) *Hospital and Clinical Pharmacy*. Birla Publications.
9. Ahmad, A., et.al (2011) *A Textbook of Hospital and Clinical Pharmacy*, 1<sup>st</sup> ed. CBS Publishers.
10. DiPiro, J.T (2002) *Encyclopedia of Clinical Pharmacy*. CRC Press.
11. Deb, A.C. *Clinical Pharmacy and Therapeutics*.
12. Wiffen, P (2017) *Oxford Handbook of Clinical Pharmacy*, 3<sup>rd</sup> ed. Oxford University Press.
13. Longmoer, M (2014) *Oxford Handbook of Clinical Medicine*, 9<sup>th</sup> ed. Oxford University Press.

<b>Course Code: PHARM-4811</b>		
<b>Course Title: Pharmaceutical Marketing and Management</b>		
<b>Credit Hours: 03</b>	<b>Contact hours per week: 03</b>	<b>Total Hours: 45</b>

**Course Objectives:** To provide idea about various aspects of purchasing, inventory management, production management, launching of new drugs, pricing and advertising of pharmaceutical drugs.

**Course Outcome:** At the end of this course, students will be able to:

- Identify core concepts of marketing and the role of marketing in business and society.
- Gain knowledge of social, legal, ethical and technological forces on marketing decision-making of an organization.
- Develop marketing strategies based on product, price, place and promotion objectives.
- Collect, process, and analyze consumer data to make informed marketing decisions.

### **Section-A (Mid-term: 30 Marks)**

#### **1. Personnel Management:**

- a) Definition, scope, importance, behavioral science and personnel management.
- b) Motivation, moral and job satisfaction.
- c) Education, training, management development and performance evaluation.
- d) Means of achieving harmonious industrial relation collective bargaining, joint consultation worker council, arbitration, and industrial democracy.

#### **2. Production Management:** Definition, scope, importance and application of management, techniques and principles to production management, production planning and quality control.

### **Section-B (Final Exam: 50 Marks)**

#### **Group-A (20 Marks)**

#### **3. Pharmaceutical Marketing:**

- a) **Promotion:** Objectives, classification, developing a promotional plan, promotion strategy, budget and executing the program, setting total promotional budget and mix, steps of implantation of advertising, types (display, direct mail, etc.) and preparation of advertisement, personal selling and evaluation of promotion (general and specialized method).
- b) **Pricing:** General consideration, pricing method, prescription pricing and professional fees.
- c) **Channel of distribution**
- d) **Forecasting of sales**

#### **Group-B (30 Marks)**

#### **4. Materials Management:**

- a) **Purchasing:** Formulating effective buying policies, determination of needs and desires of patrons, selecting the sources of supply, determination the terms of purchase, receiving, marketing and stocking goods.
- b) **Inventory control:** Methods of inventory control, selection of optimum method, effect of inventory control.
- c) **Marketing channels and supply chain management:** Nature, importance, behavior, organizations, management and design.

#### **5. Retailing and Whole Selling:** Definition, types, decision, future of retailing.

#### **Recommended Books:**

1. Kotler, P.T and Armstrong, G. (2015) *Principles of Marketing*, 16<sup>th</sup> ed. Pearson.
2. Smith, M.C (2014) *Principles of Pharmaceutical Marketing*, 3<sup>rd</sup> ed. Routledge.

3. Kotler, P.T and Keller, K.L (2015) *Marketing Management*, 15<sup>th</sup> ed. Pearson.
4. Jain, K.C and Agarwal, L.N (2014) *Production Planning Control and Industrial Management*. Khanna.
5. Ali, M and Gupta, J (2007) *Drug Store and Business Management (Including Accountancy)*, 1<sup>st</sup> ed. CBS.
6. Gupta, A.K (2007) *Handbook of Drug Store and Business Management*. CBS Publishers.
7. Smith, H.A (1986) *Principles and Methods of Pharmacy Management*, 3<sup>rd</sup> ed. Lea and Febiger.

<b>Course Code: PHARM-4813</b>
--------------------------------

<b>Course Title: Oral Assessment-IV</b>
---

<b>Credit Hours: 01</b>
-------------------------

**Course Objectives:**

- To ensure comprehension of the topics covered in class and in the reports.
- To improve students' presentation and communication skills.
- To preparing students for the types of oral assignments required in future linguistic course.

**Course Outcomes:** At the end of the course, the student will be able to:

- Gain deeper insights on the topics covered courses.
- Enhance students' self-confidence for the future viva-voce.

**Course Contents:** Previous courses of this syllabus, basic knowledge and miscellaneous.

<b>Course Code: PHARM-4814</b>
--------------------------------

<b>Course Title: Project</b>
------------------------------

<b>Credit Hours: 03</b>
-------------------------

**Course Objectives:** To provide a platform for the innovative research and development in the different areas of pharmaceutical science.

**Course Outcomes:** At the end of the course, the student will be able to:

- Understand basic framework of research process.
- Design and develop various research protocols and techniques.
- Identify various sources of information for literature review and data collection.
- Develop an understanding of the ethical dimensions of conducting applied research.
- Appreciate components of scholarly writing and evaluate its quality.
- Improve presentation skills.

**Course Content:** Research works assigned by respective supervisor.

**Field of Works:** Pharmaceutical Technology, Pharmaceutics, Pharmaceutical Microbiology, Pharmacognosy and Phytochemistry, Pharmacology, Molecular Biology, Pharmaceutical Biotechnology, Medicinal Chemistry, Survey, Review etc.

<b>Course Code: URBS-4802</b>
-------------------------------

<b>Course Title: Bangladesh Studies and History of Independence</b>
---

<b>Credit Hours: 02</b>
-------------------------

<b>Contact hours per week: 02</b>
-----------------------------------

<b>Total Hours: 30</b>
------------------------

**Course Objectives:** The objective of this study is to create awareness among the students about the History and Heritage, Geography and Environment, People and Society, Politics and Constitutional Development, International Relations, Economics and Natural Resources, Education and Literature, Philosophy and Religion, Art and Culture of Bangladesh and such other conceptions and ideas that are significantly related to the people and society of Bangladesh with a view to develop patriotism among the learners.

**Course Outcomes:** By studying this course, the learners will be able to have a comprehensive and clear concept about the historical developments of Bengali nation from pre-historic age until the independence from British government in 1947. The students will also be able to understand the geographical characteristics of Bangladesh, Origin of its people, Population growth, distribution and challenges, Political developments and crises of Democracy in Modern Bangladesh, Foreign Policy and international relations of Bangladesh, Constitutional development of Bangladesh. This comprehensive study will undoubtedly increase patriotism among the students towards the beloved Motherland Bangladesh. The learners will also be able to appreciate any significant national issue in context of demand of time and future integrities.

### **Section A (Midterm Examination: 30 Marks)**

- 1. Outline study of Bangladesh Geography:** Location, Area, Boundary, Physiographical features, River System, Forest and Climate. Geographical Impact on the People and Society.
- 2. The People of Bangladesh:** Origin of the People, Population growth and composition, Literacy, Population challenges and prospects for Bangladesh.
- 3. History and Society of Ancient Bengal:** The old Regions of Bengal, Pre-historic and Pre-Aryan Civilization in Bengal, Bengal under Gupta, Pala and Sena Dynasties, Socio-economic condition of Bengal before the advent of Islam.

### **Section B (Final Examination: 50 Marks)**

- 4. History and Society of Bengal under Muslim Rule (1204-1757):** Advent of Islam in Bengal and the Muslim conquest, its impact on the people and society, origin and composition of the Muslim society in Bengal, impact of Sufism, the consolidation of Muslim rule (1204-1757), educational and literary development in Muslim Bengal, the evaluation of over-all impact of Muslim rule on the people and society of Bengal.
- 5. History and Society of Bengal under British Rule (1757-1947):** The introduction of British rule in Bengal, British policy towards economy and education. A brief discussion on the socio-religious reform movements in Bengal and the struggles for freedom from the British Colonialism, Intellectual Movements, Partition of Bengal and its impact, formation and role of Muslim League and Congress, development of Bengali Literature, rising of the nationalism movements and the creation of Pakistan, impact of British administrative policy on the society of Bengal.
- 6. Constitutional Development of Bangladesh:** Background to the constitution, characteristics, contents, constitutional organizations, amendments and administrative structure of Bangladesh.
- 7. Political Developments of Modern Bangladesh:** formation and role of the major political parties, regime analysis of modern Bangladesh, critical issues of Bangladesh politics including Caretaker Government System, Students Politics, Crises of Democracy, etc.
- 8. Foreign Policy and International Relations of Bangladesh:** emergence of Bangladesh and the global super powers, principles of foreign policy, international relations of Bangladesh, the role of Bangladesh in the international organizations such as the UN, OIC, SAARC, ASEAN, BIMSTEC etc. Millennium Development Goals (MDGs), Sustainable Development Goals (SDGs) and Bangladesh.
- 9. Economic condition of Bangladesh, minerals and natural resources of Bangladesh.**
- 10. Socio-cultural problems and prospects of Bangladesh.**

**Recommended Books:**

1. Sirajul Islam (ed.), *Banglapedia: National Encyclopedia of Bangladesh*, Vol- 1-14, Asiatic Society of Bangladesh, Dhaka, 1998.
2. Harun Er Rashid, *Geography of Bangladesh*, University Press Limited, Dhaka, Bangladesh, 1991.
3. Mosharraf Hossain, *Graphoman World Atlas*, 7<sup>th</sup> edition, Graphosman, Dhaka, 2012.
4. Mohar Ali, *History of the Muslims of Bengal*. Vol – 1-3, Islamic Foundation Bangladesh, Dhaka, 2003.
5. Abdul Karim, *Social History of the Muslims of Bengal*, Baitush Sharaf Islamic Research Institute, Chittagong, Bangladesh, 1985.
6. Dr. Enamul Huq, *A History of Sufism in Bengal*, Bangla Academy, Dhaka, 1975.
7. Board of Researchers, *Islam in Bangladesh through Ages*, Islamic Foundation Bangladesh, 1995.
8. Sufia Ahmed, *Muslim Community in Bengal (1884-1912)*, Oxford University Press, Dhaka, 1974.
9. M.A. Rahim, *The Muslim Society and Politics in Bengal*, University of Dhaka, Bangladesh, 1978.
10. Prof. Dr. Muinuddin Ahmed Khan, *Islamic Revivalism*, Bangladesh Institute of Islamic Thought (BIIT), 2010.
11. Dr. Muinuddin Ahmed Khan, *Muslim Struggle for freedom in Bengal*, Islamic Foundation Bangladesh, 1983.
12. Dr. Muhammad Inamul Huq, *Varoter Musalman O Shwadinota Andolan*, Bangla Academy, Dhaka, 1995.
13. Azizur Rahman Mallick, *British Policy and the Muslims in Bengal*, Asiatic Society of Pakistan, Dhaka, 1961.
14. Dr. M.A. Rahim, and others, *Bangladesher Itihash*, Nowroz Kitabistan, Dhaka, Bangladesh, 1994.
15. Md. Thowhidul Islam and others, *Bangladesh Studies*. Bangladesh Institute of Islamic Thought (BIIT), 2017.
16. Abbas Ali, Khan, *Banglar Musalmander Itihash*, Bangladesh Islamic Center, Dhaka, 2002.
17. Sirajul Islam, *History of Bangladesh*, Vol – 1-3, Asiatic Society of Bangladesh, Dhaka, 2008.
18. Abul Asad, *Eksho bochorer Itihas*, Bangladesh Co-operative Book Society, Dhaka, 1997.
19. M.A. Barnik, *Rasthra Bhasha Andolonon Itihas*, AHDPH.
20. Oli Ahad, *Jatiyo Rajniti 1945-1975*, Bangladesh Co-operative Book Society, Dhaka, 2004.
21. Abul Mansur Ahmad, *Amar Dekha Rajniteer Poncash Bochor*, Srijon Prokashoni Ltd. Dhaka, 1988.
22. Kamruddin Ahmed, *Social History of East Pakistan*, Dacca, Crescent Book Center, 1967.
23. Siddiq Salik, *Witness to Surrender*, The University Press Ltd., 1997.
24. Moudud Ahmed, *Bangladesh: Constitutional Quest for Autonomy*, The University Press Ltd., 2003.
25. Akbar Ali Khan, *Discovery of Bangladesh*, The University Press Ltd., 2009.
26. Talukdar Maniruzzaman, *Bangladesh Revolution and its Aftermath*, University Press Ltd., 1992
27. Shamsul I. Khan, *Political Culture, Political Parties and the Democratic Transition in Bangladesh*, The University Press Ltd., 2008.
28. The Constitution of the People's Republic of Bangladesh.
29. Md. Abdul Halim, *Constitution, Constitutional Law and Politics: Bangladesh Perspective*, Dhaka, 1998.

**Useful web links:**

- [www.bangladesh.gov.bd](http://www.bangladesh.gov.bd)
- [www.bangladesh.com](http://www.bangladesh.com)
- [www.banglapedia.org](http://www.banglapedia.org)
- [www.ru.ac.bd/ibs/](http://www.ru.ac.bd/ibs/)
- [www.bbs.gov.bd](http://www.bbs.gov.bd)

**Mapping of Course Outcomes (CO) to Program Outcomes (PO) at Course Level and Program Level:**

PO →	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO ↓											
PHARM-1101										✓	✓
PHARM-1103	✓		✓								
PHARM-1104			✓								
PHARM-1105	✓										
PHARM-1106			✓								
PHARM-1107				✓							
COMP-1101								✓	✓		
UREL-1106										✓	
UREM-1101										✓	
PHARM-1201	✓						✓				
PHARM-1202			✓								
PHARM-1203							✓				✓
PHARM-1204			✓								
PHARM-1205	✓		✓								
PHARM-1206			✓								
PHARM-1207				✓				✓			
PHARM-1208								✓			
PHARM-1213								✓			
MATH-1201	✓							✓			
URED-1201										✓	
PHARM-2301	✓	✓									
PHARM-2303							✓				✓
PHARM-2304			✓								
PHARM-2305				✓					✓		
PHARM-2307				✓							
PHARM-2308								✓			
PHARM-2309					✓			✓			
PHARM-2310	✓		✓								
STAT-2301								✓			
STAT-2302			✓								
URED-2302										✓	
URED-2305										✓	
PHARM-2401	✓	✓									
PHARM-2402	✓										
PHARM-2403				✓					✓		
PHARM-2404						✓					

PHARM-2405				✓		✓					
PHARM-2406						✓					
PHARM-2407					✓				✓		
PHARM-2409		✓	✓								
PHARM-2410			✓								
PHARM-2413								✓			
URBL-2401										✓	
PHARM-3501	✓	✓									
PHARM-3502	✓										
PHARM-3503						✓					
PHARM-3504			✓								
PHARM-3505				✓		✓					
PHARM-3506						✓					
PHARM-3507							✓		✓		
PHARM-3508							✓				
PHARM-3509	✓				✓						
URED-3503										✓	
PHARM-3601	✓	✓									
PHARM-3603						✓					
PHARM-3604			✓								
PHARM-3605								✓		✓	
PHARM-3607							✓		✓		
PHARM-3608							✓				
PHARM-3609		✓	✓								
PHARM-3610			✓								
PHARM-3611	✓	✓									
PHARM-3613								✓			
URED-3604										✓	
PHARM-4701	✓	✓									
PHARM-4702	✓										
PHARM-4703	✓									✓	
PHARM-4705				✓		✓					
PHARM-4706						✓					
PHARM-4707										✓	
PHARM-4709			✓					✓			
PHARM-4711	✓	✓									
URIH-4701										✓	
PHARM-4801											✓
PHARM-4803	✓		✓								
PHARM-4805	✓		✓								

PHARM-4806			✓								
PHARM-4807							✓		✓		
PHARM-4809				✓	✓			✓			
PHARM-4811										✓	
PHARM-4813								✓			
PHARM-4814									✓		
URBS-4802										✓	