DEPARTMENT OF PHARMACY

Faculty of Science

COMILLA UNIVERSITY

Kothari, Comilla-3506, Bangladesh

SYLLABUS

of

Bachelor of Pharmacy (B. Pharm)

Sessions: 2016-2017, 2017-2018, 2018-2019

Preface:

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

Qualification for Admission:

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

Course Curriculum:

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

Syllabus Structure

Examination	Semester	Credits	Total Credits
B. Pharm. Year I	First	14	32
	Second	18	
B. Pharm. Year II	First	21	39
	Second	18	
B. Pharm. Year III	First	20	40
	Second	20	
B. Pharm. Year IV	First	23	44
	Second	21	
B. Pharm. Year V	First	22	45
	Second	23	
Grand Total of Credits			**200**

Duration of Theory Examination

For 3 credit courses - 3 hours

For 2 credit courses - 2 hours

Industrial Pharmacy Internship: All students will be required to complete at least 4 weeks of internship in Pharmaceutical during B. Pharm Year 4: Semester- 2.

Hospital and Community Pharmacy Internship: All students will be required to complete at least 600 hours internship in Hospitals and Community Pharmacies during B. Pharm Year5: Semester-2.

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

Duration of the Academic Program:

The duration of the program shall be 5 (five academic years divided into 10 (ten) semesters. Each academic year is divided into two semesters to be called as 1st semester and 2nd semester.
An academic semester comprised of six months is distributed as follows:

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

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

a) Definition of credit hour:

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

b) Gap between examinations of two courses

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

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

Class Hours (50 minutes each)
Theoretical and Practical courses shall be so designed as to be completed of the following class hours:

a. Theoretical courses of 2 credits in 26 class hours and 3 credits in 39 class hours
b. Practical courses of 1 credits in 13×2 class hours

Degree Requirements:

a. For a student requires to:

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

b. Award of (Pass) Degree:

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

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

a. If the student has registered for the concerned semester in due time.
b. If s/he has the required percentage of attendance in each course lecture.
c. If the student has paid all dues (registration fees/tuition fees/other charges) applicable to university administration/residential hall administration etc.)
d. If the student has not been instructed by the Disciplinary Board/Examination Disciplinary Committee to refrain from taking part in the examination.

Improvement of Grade:
Only the removal of 'F' (Fail) in any course shall be allowed. Removal of 'F' in any course is permitted sitting in the final examination only for two (2) times in subsequent two semesters excluding the regular examination. In such cases results shall be one grade down (unless the result is a "D" grade) in tabulation and calculation of CGPA.

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

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

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

Evaluation System:

A. Theoretical courses

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

Continuous Assessment /Before-Final Assessment	40%
Semester-Final Examination	60%
Total =	**100%**

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

i. ***Internal Evolution:***

a) Mid-Semester examination (At least Two mid-semester exams.) 20%

b) Class Test and/or Quiz and/or In-course and/or Sudden test and/or tutorial and/or Assignment and/or Term paper preparation & presentation/ Case study and/or practical and/or Field work* 15%

Class Attendance 5%

Total = 40%

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

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

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

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

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

ii. A student with class attendance of less than 40% in any course will be debarred from appearing in the Final Examination.

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

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

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

B. Practical Courses

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

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

Continuous Assessment:	**40%**
Lab Attendance:	10%
Lab Performance:	20%
Lab Report Writing:	10%
Final Assessment:	**60%**
Evaluation on Experiments:	50%
Viva-voce:	10%

Detail distribution of Marks for the evaluation on experiment will be decided by the Examination Committee and the course teachers.

Courses and Credits

B. Pharm Year 1: Semester 1		
Course Code	**Course Title**	**Credit/s**
PHARM 1101	Introduction to Pharmacy	2
PHARM 1102	PharmacognosyandPhytochemistry-I	3
PHARM 1103	Physiology-I	3
PHARM 1104	Basic Human Anatomy	2
PHARM 1105	Computer Applications in Pharmacy	2
PHARM 1106	Basic Mathematics	2
	Total Credits	**14**
B. Pharm Year 1: Semester-2		
PHARM 1201	Pharmaceutical Microbiology and Immunology	3
PHARM 1202	PharmacognosyandPhytochemistry-II	3
PHARM 1203	Physiology-II	3
PHARM 1204	Pharmaceutical Engineering	3
PHARM 1205	Pharmaceutical Microbiology and Immunology-Lab	1
PHARM 1206	PharmacognosyandPhytochemistry-Lab	2
PHARM 1207	Physiology-Lab	2
PHARM 1208	Viva voce	1
	Total Credits	**18**
B. Pharm Year 2: Semester-1		
PHARM 2101	Pharmaceutics-I	3
PHARM 2102	Pharmacology-I	3
PHARM 2103	Pharmaceutical Inorganic Chemistry-I	3
PHARM 2104	Pharmaceutical Organic Chemistry-I	3
PHARM 2105	Physical Pharmacy-I	3
PHARM 2106	Biochemistry and Molecular Biology	3
PHARM 2107	Pharmaceutics-I-Lab	1
PHARM 2108	Pharmacology-I-Lab	1
PHARM 2109	Biochemistry and Molecular Biology-Lab	1
	Total Credits	**21**
B. Pharm Year 2: Semester-2		
PHARM 2201	Pharmaceutical Inorganic Chemistry-II	3
PHARM 2202	Pharmaceutical Organic Chemistry-II	3
PHARM 2203	Physical Pharmacy-II	3
PHARM 2204	Applied Microbiology	2
PHARM 2205	Pharmaceutical Inorganic Chemistry-Lab	2
PHARM 2206	Pharmaceutical Organic Chemistry-Lab	2
PHARM 2207	Physical Pharmacy-Lab	2
PHARM 2208	Viva voce	1
	Total Credits	**18**

B. Pharm Year 3: Semester-1		
PHARM 3101	Pharmaceutical Analysis-I	3
PHARM 3102	Medicinal Chemistry-I	3
PHARM 3103	Biopharmaceutics-I	3
PHARM 3104	Pharmaceutical Biotechnology	3
PHARM 3105	Pharmaceutical Product Development	3
PHARM 3106	Environmental Sciences and Control	3
PHARM 3107	Pharmaceutical Analysis-I-Lab	1
PHARM 3108	Medicinal Chemistry-I-Lab	1
	Total Credits	**20**

B. Pharm Year 3: Semester-2		
PHARM 3201	Pharmaceutics-II	3
PHARM 3202	Pharmacology-II	3
PHARM 3203	Biopharmaceutics -II	3
PHARM 3204	Clinical Pathology	3
PHARM 3205	Pharmaceutical Marketing and Management	3
PHARM 3206	Pharmaceutics -II-Lab	1
PHARM3207	Pharmacology-II-Lab	1
PHARM 3208	Biopharmaceutics-Lab	2
PHARM 3209	Viva voce	1
	Total Credits	**20**

B. Pharm Year 4: Semester-1		
PHARM 4101	Pharmaceutical Analysis-II	4
PHARM 4102	Medicinal Chemistry-II	3
PHARM 4103	Drug and Disease Management-I	3
PHARM 4104	Clinical Pharmacy	4
PHARM 4105	Pharmaceutical Finance Affairs	4
PHARM 4106	Hospital and Community Pharmacy	3
PHARM 4107	Pharmaceutical Analysis-II-Lab	1
PHARM 4108	Medicinal Chemistry-II-Lab	1
	Total Credits	**23**

B. Pharm Year 4: Semester-2		
PHARM 4201	Pharmceutics-III	4
PHARM 4202	Pharmacology-III	4
PHARM 4203	Cosmetology	3
PHARM 4204	Pharmacoeconomics and Policy	4
PHARM 4205	Pharmaceutics-III-Lab	1
PHARM 4206	Pharmacology-III-Lab	1
PHARM 4207	Cosmetology-Lab	1
PHARM 4208	Pharmaceutical Internship	2
PHARM 4209	Viva voce	1
	Total Credits	**21**

B. Pharm Year 5: Semester-1		
PHARM 5101	Quality Control and Analytical Method Validation	4
PHARM 5102	Nutraceuticals and Herbal Medicine	4
PHARM 5103	Drug and Disease Management-II	4
PHARM 5104	Clinical Research and Clinical Pharmacokinetics	3
PHARM 5105	Biostatistics	3
PHARM 5106	Bioinformatics	2
PHARM 5107	Quality Control and Analytical Method Validation-Lab	1
PHARM 5108	Clinical Research and Clinical Pharmacokinetics-Lab	1
	Total Credits	**22**
B. Pharm Year 5: Semester-2		
PHARM 5201	Toxicology and Drug Interactions	4
PHARM 5202	Pharmacy Practice	4
PHARM 5203	Drug and Disease Management-III	4
PHARM 5204	Pharmaceutical Regulatory Affairs and Ethics	3
PHARM 5205	Hospital and Community Pharmacy Internship	3
PHARM 5206	Research Project	3
PHARM 5207	Viva voce	2
	Total Credits	**23**

B. Pharm Year 1: Seemester-1
Course Title: Introduction to Pharmacy
Course Code: PHARM 1101
Credits: 2

1. History and Evaluation of Pharmacy: Ancient ages, middle ages, modern ages, development of pharmacy in International and Bangladesh, important pharmacy dates.

2. Pharmacy Education: Definition of pharmacy, specialty of pharmacy education, brief introduction of the courses taught in a pharmacy program, pharmacy education in Bangladesh and other countries.

3. Pharmacy Occupation and Profession: Difference between occupation and profession, pharmacy as a profession, definition and characteristics o f pharmacy profession, social recognition and status of pharmacy profession, scopes and opportunities for pharmacists, career development in pharmacy – International and Bangladesh perspective.

4. Multi-systems of Medicine: Definition of medicine, different systems of medicine, allopathic, ayurvedic, unani and homeopathic systems of medicine, other systems of medicine, recent interests in herbal medicines.

5. Pharmacists' Code of Ethics: Oath of a pharmacist, professional pharmacy organizations in Bangladesh and abroad, local and foreign drug regulatory bodies.

6. Drugs and Medicines: Definition and difference between drug and medicine, sources of drugs, classification of drugs on the basis of actions, target organs, chemical, generic and brand names, different types of dosage forms.

7. Drug Standards: Different pharmacopoeias and formularies (USP, BP, NF, BNF, BDNF etc.), pharmaceutical codex, index official, non-official, unofficial and INN drugs (new drugs), monographs of drugs, drug regulation and control.

8. 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.

9. WHO and Essential Drug Concept.

10. Some common terms and abbreviations used in pharmaceutical sciences.

Recommended Books:

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

* Other Books will be indicated by respective teachers

B. Pharm Year 1: Seemester-1
Course Title: Pharmacognosy and Phytochemistry-I
Course Code: PHARM 1102
Credits: 3

1. Introduction to Pharmacognosy: Definition, scope and historical development of Pharmacognosy.
2. Plant Cell: Its structure, function and form, introduction to the general structure of the morphological parts of the plants.
3. Crude Drugs: A general view of their origin, distribution, cultivation, collection, drying and storage, commerce and quality control, classification of drugs, preparation of drugs for commercial market, drug adulteration, evaluation of crude drugs.
4. Plant Analysis: Extraction, separation, chromatography; types of plant constituents, comparative phytochemistry and chemotaxonomy.
5. Lipids: Definition, classification, properties and extraction of the following-
a) Plant origin: castor oil, coconut oil, linseed oil, olive oil, peanut oil and chaulmoogra oil.
b) Animal origin: cod liver oil, shark liver oil, hilsha fish/liver oil etc.
c) Waxes
6. Carbohydrate and Related Compounds: Definition, classification, properties and biosynthesis.
a)Monosacharides and oligosaccharides: Sucrose, dextrose, glucose, fructose etc.
b) Polysaccharides and polysaccharide-containing drugs: Starch, dextrin, cellulose, etc.
c) Gums and mucilages: Tragacanth, acacia, sodium alginate, agar etc.
7. Alkaloids: Definition, nomenclature, classification, distribution, properties, test, extraction and biosynthesis. Study of the following alkaloidal drugs: a) areca, conium b) lupinus and c) ephedra and colchicum.
8. Phenolic Compounds and Tannins: Definition, classification, properties and tests, study of tanin containing drugs such as nutgall, catechu, etc.
9. Contribution of Traditional Drugs to Modern Medicines: Details of some common indigenous traditional drugs: punarnava, vashaka, anantamul, arjuna, chirata, picrorhiga, kalomegh, amla, asoka, bahera, haritaki, tulsi, neem, betel nut, joan, karela, shajna, carrot, bael, garlic, black cumin, jam and madar.
10. Surgical Dressings and Fibres: Classification, importance and brief study of different types of surgical dressings and fibres.

Recommended Books:

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

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

B. Pharm Year I: Semester-1
Course Title: Physiology-I
Course Code: PHARM1103
Credits: 3

1. Introductory Physiology and General Physiology: Physiology and its scope in pharmacy, definition, classification, interaction of physiology with various branches of pharmacy, approaches of physiology, structure of cell, physiology of cell and body fluids– various components and organelles, their structures and functions with special reference to endoplasmic reticulum, golgi apparatus, RNA, DNA, body fluid compartments and composition of body fluid, transport across cell membrane and membrane potentials, intercellular communication and homeostasis.

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

3. Blood System:

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

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

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

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

4. Cardiovascular System: Heart- structure and blood circulation, cardiac muscles and their properties, origin of heart beat and action potential, cardiac cycle, heart sounds, cardiac output, ECG, regulation of cardiac function, blood pressure- types, significance, measurement and regulation, hypertension- types and causes.

5. Digestive System: Structure of different parts of alimentary system, gastrointestinal motility and its control, swallowing and defaecation; secretion of digestive juices from saliva, stomach, pancreas; functions of digestive juices and their mechanism and regulation of secretions; digestion and absorption of various food stuffs; liver and its function, formation of bile and its circulation.

6. Respiratory System: Organs of respiratory system and its structure, inspiration and expiration, mechanism of respiration, pulmonary ventilation, ventilation volumes, gaseous exchange through lungs, transport of O_2 and CO_2, hypoxia and eschemia- causes and classification.

Recommended Books:

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

* Other necessary books will be referred by the respective course teache

B. Pharm Year I: Semester-1
Course Title: Basic Human Anatomy
Course Code: PHARM 1104
Credits: 2

1. Nervous System: CNS- brain & spinal cord; PNS- spinal nerve & autonomic nervous system (sympathetic & parasympathetic).
2. Alimentary System: Oral cavity, pharynx, esophagus, stomach, small intestine, caecum, appendix, colon, sigmoid, rectum, anal canal.
3. Respiratory System: Nose, pharynx, larynx, trachea, bronchus and lung.
4. Cardiovascular System: Heart, heart valve, ascending, descending, thoracic, and abdominal aorta, arch of the aorta.
5. Urinary System: Kidney, ureter, urinary bladder, urethra.
6. Reproductive System: Female- ovary, uterus with fallopian tube, cervix, vagina; Male- testis, ductusdiferens, seminal vesiele, prostate, urethra; External genitalia: male- scrotum, penis; female- labium majora, labium minora, clitories, vaginal orifice.
7. Metabolic Organ: Liver with gall bladder.
8. Exocrine Gland: Parotid gland, submandibular gland, pancreas.
9. Endocrine Gland: Pituitary gland, thyroid & parathyroid gland, pancreas, adrenal gland, ovary, testis.
10. Reticulo Endothelial System: Spleen, thymus, tonsil, lymph node, bone marrow.

Recommended Books:

1. Susan Standring : Gray's Anatomy
2. Keith L Moore, Anne M R Agur : Essential Clinical Anatomy
3. Saladin : Anatomy & Physiology: The Unity of Form and Function.
4. Dr. AbdusSattar : Basic Anatomy and Physiology
5. Ross and Wilson : Anatomy and Physiology in Health and Illness

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

B. Pharm Year I: Semester-1
Course Title: Computer Applications in Pharmacy
Course Code: PHARM1105
Credits: 2

1. Introduction to Computers: History of development of computer, application and scope of computer in pharmacy- drug discovery and development, formulation and dosage form research and development, hospital management, prescription and patient management, preclinical and clinical trials, biopharmaceutical data analysis, industry management, quality control and analysis, chemo-informatics and bioinformatics, drug information system etc.
2. Classification of Computer: Mainframe, mini and micro computer, computer architecture- a general review of INPUT/OUTPUT media and devices, functional part and organization of central processing

unit, memory and memory storage devices, micro processors, number systems- binary, hexadecimal etc., hardware, software, batch processing, RAM, ROM etc.

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

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

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

Recommended Books:

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

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

B. Pharm Year I: Seemester-1
Course Title: Basic Mathematics
Course Code: PHARM 1106
Credits: 2

1. Introduction to Mathematics: Variables, constant and parameter, co-ordination system with graph.

2. Functions: Odd function, Even function, one-one function, onto function, variable substitution in function, composition of functions.

3. Limit of Function: Limit, graphical representation of limit, Evaluation of different types of limit.

4. Graphs and Gradients: (a) Rectangular co-ordinates, curve fitting gusting first degree equation in both variables, determination of slope, intercept and points of intersection, equation of first degree in both x and y (circle), ellipse, rectangular hyperbola etc. (b) Exponential and logarithmic curves, graphical solution equation, graphical solution of simultaneous equation. (c) Arithmetic progression, geometric progression, permutation, combination, the binomial theorem and exponential theorem.

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

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

Recommended Books:

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

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

B. Pharm Year I: Semester-2
Course Title: Pharmaceutical Microbiology and Immunology
Course Code: PHARM 1201
Credits: 3

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

2. History and Evolution of Microbiology: Historical development, evolution of microbiology, spontaneous generation and biogenesis, germs theory of diseases, pure culture concept, immunization, widening horizons.

3. Microscopy of Microorganisms: Bright field, dark field, fluorescence and phase contrast microscopy, electronic microscopy, preparations for microscopic examinations, wet mount and hanging drop techniques, fixed and stained smears, microbiological stains- simple and differential staining methods.

4. Bacteria:

a) Nomenclature of bacteria, general characteristics of bacteria.

b) General and cellular morphology - size, shape, fine structures and movement.

c) Cultivation of bacteria: nutritional requirements, factors affecting growth, bacteriological media.

d) Reproduction and growth: Modes of cell division, normal growth cycle, growth curve, syncHouronous growth and quantitative measurement of growth.

e) Pure culture and cultural characteristics: Methods of isolation, maintenance and preservation of pure cultures, colony characteristics and characteristics of broth culture, maintenance and preservation of pure culture of bacteria.

f) Microbial metabolisms: Introduction, biogenesis, anabolism, catabolism, metabolic versatility of organisms, enzymes, energy production by aerobic & anaerobic processes, fermentation processes.

5. Virus:

a) History of viruses, general properties of viruses, classification of viruses, characteristics of viruses, reproduction and cultivation of viruses, virus inhibition, control of viral infections.

b) Bacterial virus or bacteriophages: Morphology, composition and life cycle, cultivation of bacterial viruses, virus & diseases, applications in life sciences.

6. Other Microorganisms (brief study):

a) Fungi- pharmaceutical importance, characteristics, morphology, reproduction (sexual & asexual), cultivation, classification of fungi, some fungi of special interest (Penicillium, Candida, Aspergillus, Rhizopus), diseases caused by fungi.

b) Rickettsiae – Introduction, characteristics of rickettsiae, pathogenic rickettsiae, laboratory diagnosis of rickettsial diseases.

Brief study of actinomycetes

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year I: Seemester-2
Course Title: Pharmacognosy and Phytochemistry-II
Course Code: PHARM 1202
Credits: 3

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

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

a) Phenols and phenolic glycosides.

i) Simple phenols: Vanilla and vanillin, capsicum

ii) Tannins: Galls or nutgall, hamamelis.

iii) Anthraquinone glycosides: Cascara sagrada, aloe, senna, rhubarb.

b)Saponins, cardioactive drugs and other steroids.

i) Steroidal saponin: Sarsaparilla root, ginseng, glycerhizia.

ii) Pentocyclictriterpenoidsaponin.

iii) Cardioactive glycosides: Digitalis, strophanthus, squill.

iv) Cyanogenic glycoside: Wild cherry, mustard.

v) Miscellaneous isoterpenoids: Gentain, valerian root, quassia, fish berries, santonica flower, saffron.

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

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

i) Tropane: Belladona, stramonium, hyoscyamus and coca leaf.

ii) Quinoline: Cinchona, cusparia bark.

iii) Isoquinoline: Ipecac, opium, sanguinaria, curare.

iv) Indole: Rauwolfia, nux vomica, ergot, catharanthus.

v) Imidazole: Pilocarpine.

vi) Steroidal: Veretrumviride, aconite.

vii) Norlupinane: Lupinus sp.

viii) Purine base: Coffee, tea and cocoa.

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

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

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

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

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

Recommended Books:

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

* Other Books will be indicated by respective teache

B. Pharm Year I: Semester-2
Course Title: Physiology-II
Course Code: PHARM 1203
Credits: 3

1. Nervous System:

a) Neuron- properties, classification and functions; neuroglial cells and their functions; nerve fibres-definition, types, properties of nerve fibres, origin and propagation of nerve impulses across nerve fibres, action potential; synapse- classification, structure, properties and functions; neurotransmitters- classifications and funtions, never endings.

b) Different types of sensations- mechanism and properties of sensations; receptors- definition, classifications, properties and functions.

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

d) Principal division of nervous system - CNS and PNS, functions of different parts of CNS, ascending and descending tracts of spinal cord, differences between - somatic & autonomic, and sympathetic & parasympathetic nervous system; cranial and spinal nerves & their functions, regulation of autonomic nervous system; muscle tone- definition & regulation; CSF- definition, composition and function.

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

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

4. Endocrine System: Introduction to different endocrine glands.

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

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

c) Parathyroid gland: organization, secretion and function of hormone, Ca^{+2} metabolism, and tetany.

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

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

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

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

6. Temperature Control: Heat production and heat dissipation, hypothalamus and nervous factors involved in body temperature regulation, function of skin.

7. Special Senses:

a) Eye: optical apparatus, visual apparatus, accommodation, field vision and color vision and disorders.

b) Ear: Physiology of hearing, apparatus, structure and function of organ of corti, transmission of sound, mechanism of hearing, disorders of ear.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year I: Semester-2
Course Title: Pharmaceutical Engineering
Course Code: PHARM 1204
Credits: 3

1. **Drying:** Definition, importance of drying, terminology, theory & fundamental concepts, periods of drying, constant rate period, falling rate period, critical moisture content. equilibrium moisture content, classification : direct, indirect, radiation, dielectric, batch and continuous, dryers, types of beds: static, moving, fluidized, pneumatic bed systems, different drying equipments(construction, operation, merits, demerits): tray dryer, through-circulation dryer, pneumatic conveying dryer, rotary dryer, spray dryer, tunnel dryer, steam tube rotary dryer, agitated pan dryer, vacuum rotary dryer and freeze dryer, selection of drying equipment, preliminary dryer selection, drying tests, final selection.

2. **Filtration:** Definition, importance of filtration, difference with expression, sedimentation and drying. Classification of filters, theory of filtration, filter media, filter aids, filter thickeners, different filtration equipment :(construction, operation, merits and demerits) the gravity nutsche, delpark industrial filter, bag filters, sand filters, plate and frame press, recessed plate filter press, Eimco-Burwell plates and frames, Readco short cycle filter, vertical pressure leaf filter, horizontal plate filter, industrial tubular filter, Rodney Hunt pressure filter, Moore filter, vacu-flow suction leaf filter, string discharge filter, clarifying filters, selection of filtration equipment.

3. **Centrifuges:** General principles, magnitude of centrifugal force, materials of construction, critical speed. sedimentation centrifuges, filtering centrifugal, centrifuge auxiliaries, drive mechanisms, feed and discharge lines, feed treatment, selection of centrifugal separators.

4. **Mixing:**
   a) **Solid-Solid Mixing:** Importance, fundamentals, batch homogeneity, types of solids-mixing machines: (mixing mechanisms and operations) double cone, twin shell, horizontal drum, double-cone revolving around long axis, ribbon, vertical screw, batch muller, continuous muller, twin rotor. Performance, characteristics, selection of machines.
   b) **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.
   c) **Liquid Mixing:** Definition, importance, mixing equipment, axial and radial flow impellers, mechanisms, flow patterns, impellers, flat-blade and curved blade turbines, spiral turbines, paddles, gate impellers, anchor impellers, different fixed-mounted and portable positions, shaft lengths, baffled and unbaffled tanks, vortex formation and its control, selection of impeller.

5. **Milling:** Definition, application and limitations, factors affecting milling operation, mechanisms of size reduction process, methods of size reduction by cutter mill, roller mill, hammer mill, ball mill, vibration mill, edge runner mill, end runner mill, fluid energy mill, hand mill, colloid mill (principle, design, operation and advantages) and selection of a mill.

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

a) Air conditioning: Definition, importance, pharmaceutical application, differences between air conditioner & air cooler, comfort zone, different types of air conditioners, selection of an air conditioner, design of an air conditioned room, pharmaceuticals needing air conditioning.

b) Refrigeration: Definition, pharmaceutical application, refrigerators design, mechanism of cooling, refrigerants, brine selection, pharmaceuticals needing refrigerated storage.

c) Humidity control: Terminology (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.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year I: Semester-2
Course Title: Pharmaceutical Microbiology and Immunology-Lab
Course Code: PHARM 1205
Credit: 1

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

B. Pharm Year I: Seemester-2
Course Title: Pharmacognosy and Phytochemistry-Lab
Course Code: PHARM 1206

Credits: 2

1. The cell, cell contents and cell types.

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

ii. Cell contents – Starches and derivatives, calcium carbonate, silica.

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

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

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

a) General tests for carbohydrates.

b) Preparation and examination of starches and related products.

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

4. Study of some medical and poisonous plants of Bangladesh.

5.Pharmacognostic study of a few selected powdered drugs.

6.Chromatographic techniques: analysis of plant extracts by thin layer chromatography.

7.Study of volatile oils and some volatile oil containing drugs: Caraway, Clove, Cinnamon, Peppermint etc.

8. Detection of adulterants, (i.e. cotton seed, seasame and arachis oils) in olive oil.

9. Examination of Cod liver oil and detection of vitamin A in Cod liver oil.

10. Extraction and isolation of anthraquinone glycosides from Cascara sagrada, Aloe, Senna and Rhubarb.

11. Isolation of lycopene from tomato.

12. Isolation of β –Carotene from carrot.

13. Examination of some saponin containing drugs: Sarsaparilla, Dioscorea etc.

14. Study of few important cardioactive drugs: Digitalis, Strophanthus and Squill.

15. Study of alkaloids and some alkaloid containing drugs: Belladonna, Strammonium, Cinchona, Rauwolfia, Tea, Coffee, Tobacco, Ergot, Ephedra, Nux vomica and Areca.

16. Isolation of lactose from Cow's milk.

17. Physical and chemical tests for honey.

18. Extraction and tests of alkaloids, lipids etc.

19. Test of tannins.

B. Pharm Year I: Semester-2
Course Title: Physiology- Lab
Course Code: PHARM 1207
Credits: 2

1. Measurement of blood pressure.
2. Total count of R.B.C.
3. Total count of W.B.C.
4. Differential count of W.B.C.
5. Determination of clotting and bleeding time.
6. Determination of blood group.
7. Estimation of hemoglobin.
8.Recording of normal heart beat in toad
9. Demonstration of the effects of temperature aviation on toad heart
10. Demonstration of the effects of stannous ligatures on toad heart
11. Demonstration of the effects of drugs on toad heart
12. Demonstration of the effect of Electrolytes (Na^+, K^+, Ca^+) on toad heart.
13. Recording of respiration with stethograph.
14. Determination of ESR (Erythrocyte Sedimentation Rate).
15. Determination of Packed Cell Volume (PCV).
16. Recording of body temperature and effect of exercise on it.
17. Effect of different posture on blood pressure.
18. Collection of gastric juice; test for gastric acidity
19. Estimation of blood sugar in normal person.

B. Pharm Year I: Semester-2
Course Title: Viva voce
Course Code: PHARM 2108
Credit: 1

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

B. Pharm Year 2: Semester-1
Course Title: Pharmaceutics-I
Course Code: PHARM 2101
Credits: 3

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

2. Basic Principles of Compounding and Dispensing: Weighing, measures and units used in calculation for compounding and dispensing, fundamental operation in compounding, current good pharmaceutical practices in compounding and dispensing, containers and closures for dispensed products, responding to the prescription and labeling of dispensed medications.

3. Pre-formulation: Preliminary evaluation and molecular optimization, bulk characterization of the material crystalinity and polymorphism, thermal properties, hygroscopicity, particle characterization, bulk density, powder flow properties, solubility analysis, $_pK_a$ determination, pH solubility profile, effect of temperature, solubilization, partition coefficient, dissolution, stability analysis, solution stability, solid state stability.

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

5. Dispersed System:

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

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

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

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

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

Recommended Books:

1. A. Martin and J. Swarbrick : Physical Pharmacy

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Seemester-1
Course Title: Pharmacology-I
Course Code: PHARM 2102
Credits: 3

1. Introduction to Pharmacology: Definition of pharmacology, drug, medicine and pro drug; pharmacokinetics, pharmacodynamics, agonist, synergism, side effect, toxicity, drug interaction, drug tolerance, drug dependence, drug abuse, idiosyncrasy, dose, dosage form, absorption, distribution, bioavailability, distribution, protein binding, metabolism & excretion, routes of drug administration.
2. Basic Concept of Drug Action: Definition of drug action, different mechanisms of drug action, receptors, nature of receptors, drug antagonism, relation between drug dose & clinical response.
3. Signaling Mechanism and Drug Action: Regulation of gene expression by intracellular receptors, Ligand regulated transmembrane enzymes, legand gated channels, G-proteins and secondary messengers, such as cyclic-AMP, calcium and phosphoinositides and cyclic-GMP interplay among signaling mechanisms.
4. Drug Metabolism: Various pathway of drug metabolism, metabolism of various group of drugs, factors affecting drug metabolism with special emphasis on aging, methods of studying drug metabolism, new aspects of drug metabolism.
5. Drugs for Peptic Ulcer: General consideration, chemistry, absorption, modification, distribution and excretion. Antacids, H2 - receptor blockers, proton pump inhibitors, PG analogues, mucosal-protective agents, *Helicobacter pylori* infections.
6. Drugs Used in Haemopoietic System: (a)Anticoagulants: Heparin, calcium complexing agents, oral anticoagulants. (b) Haematinic drugs: Iron, vitB12 , folic acid, erytHouropoietin
7. Sedative & Hypnotics: Benzodiazepine & barbiturates.
8. CNS Stimulant Drugs: Strychnine, xanthine &methylxanthine, amphetamine, nicotine.
9.Chemotherapy of Parasites: Drugs used in helminthiasis, malaria, amebiasis, giardiasis, leishmaniasis&trichomoniasis.

Recommended Books:

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

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-1
Course Title: Pharmaceutical Inorganic Chemistry-I
Course Code: PHARM 2103
Credits: 3

1. Atomic Structure: Subatomic particles; Cathode rays, positive rays, αβ and γ-rays, Isotope, Isotone, Isobar, determination of atomic number, Rutherford's atomic model, electromagnetic spectrum, quantum numbers, BoHour atomic model, electron cloud and orbital, electronic configuration of atoms; Pauli's exclusion principle, Hund's rule, Aufbau principle, shapes of s, p, d, f orbitals.
2. Chemical Bonding: Boding and non-bonding electrons, electronic theory of valency, ionic bond, covalent bond, coordinate covalent bond, octet rules, characteristics of ionic, covalent and coordinate covalent compounds, Van der Wall's force, polar covalent bonds – hydrogen bond, metallic bond, theories of covalent bonding and hybridization.
3. Periodic Table: Mendeleev's Periodic law, Modern periodic table and periodicity of elements, variation of periodic properties within periods and groups, ionization potential, electron affinity, electronegativity, importance and limitation of periodic table.
4. Coordination Compounds and Complexation: Ligands or co-ordinating groups, monodentate or unidentate ligands, polydentate ligands, co-ordination number, co-ordination sphere, chelation, factors affecting the stability of metal complexes, application of chelate formation, isomerism of co-ordination compounds, valence bond theory, application of complexes in pharmacy.
5. Oxidation Reduction Reactions: Definition, oxidation number, equivalent weight of oxidant and reductant, decomposition of drugs by redox reaction, ion electron method of balancing equation, importance and determination of redox potential.
6. Gases of Pharmaceutical Applications: Medicinal gases (oxygen, nitrogen, carbon dioxide, helium, nitrous oxide, mixtures), Inert gases and their sources, electronic configuration and inertness, isolation of inert gases from dry air (chemical method) and liquid air (physical method), physical & chemical properties and uses of noble gases, conditions and types of compounds formed by inert gases.
7. Basic Concept on Acids, Bases, Salts and pH: Definitions, various theories of acids & bases, classification of acids, bases & salts, Strength of acids & bases, determination of strength gradient of acids & bases.
8. Electrolytes: Intra and extra cellular electrolytes (Na, K, Ca and Cl ions), electrolytes used in replacement therapy, acid – base balance therapy, and combination therapy of electrolytes.
9. Essential Trace Elements: Essential trace elements (Cu, Zn, Mn, S, I, Cr, Se, Co, Ni, etc.), values of copper, zinc, manganese in biological conditions and their official products.

Recommended Books:

1. S. Z. Haider : Introduction to Modern Inorganic Chemistry
2. Satya Prakash, Tuli, Basu and Madan : Advanced Inorganic Chemistry
3. R.D. Madan : Modern Inorganic Chemistry

4. B.R. Puri and L.R. Sharma : Principles of Inorganic Chemistry

* Other Books will be indicated by respective teacher

B. Pharm Year 2: Semester-1
Course Title: Pharmaceutical Organic Chemistry-I
Course Code: PHARM 2104
Credits: 3

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

2. Chemistry of Aliphatic Compounds:

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

b) Aldehydes and Ketones: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

c) Alcohols, Ethers and Epoxides: Properties, nomenclature, preparations, identifications, reactions and pharmaceutical applications.

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

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

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

4. Carbohydrates:

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

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-1
Course Title: Physical Pharmacy-I
Course Code: PHARM 2105
Credits: 3

1. Properties of Matters:
a) The gaseous state- Ideal gas laws and their derivation, Dalton's law of partial pressure, kinetic theory of gases, liquefaction of gases.
b) The liquid state- vapor pressure of liquids, effect of temperature on vapor pressure, boiling point.
c) The solid state: crystals, types of crystals and their preparation and applications in pharmacy, Isomeric, polymorphic and amorphous substances and their applications in pharmacy, tests to identify the forms.
d) Aerosols – a brief theoretical knowledge about components, applications and the commercially available aerosols.
2. Chemical Equilibria: Law of mass action, criteria of chemical equilibrium, application of law of mass action to homogenous and heterogeneous equilibrium, factors affecting equilibrium, Gibb's free energy change for chemical equilibria, , Le-Chatelier principle and its industrial application, Vant Hoff equation.
3. Chemical Thermodynamics: System, the first law of thermodynamics, work, energy, heat and enthalpy, work of expansion, internal energy, determination of internal energy, Second law of thermodynamics, the concept of entropy and entropy changes, heat change at constant volume and constant pressure, reversible, irreversible, isothermal and adiabatic changes, molar heat capacity, difference between molar heats, Joule- Thomson experiment.
Fundamentals of thermochemistry: Exothermic and endothermic reactions, thermochemical equation, heat of reaction, Laplac's and Hess's laws and its applications, bond energies.
4. Phase Equilibria: Phase, components and degree of freedom, , phase rule of one and two component system, triple point, aziotrope mixture, critical solution temperature (CST), eutectic mixture, fractional distillation, freeze drying (lyophilization).
5. Solution: Types and properties of solution, units of concentration, ideal and real solution, Henry's law, distribution of solids between two immiscible liquids, distribution law, partition coefficient, solvent extraction.
6. Solution of Electrolytes: Concentration expressions, equivalent weights, colligative properties of dilute solution, osmotic pressure, measurement of osmotic pressure, Van't Hoff and Morse equations for osmotic pressure, coefficients for expressing colligative properties.
7. Ionic Equilibria: Modern theories of acids, bases and salts, Ionization of weak acids and bases, ionization constants of acid and bases, pH, Sorensen's pH scale, Henderson equation, titration curves of acid and bases, common-ion effect, indicators and the mechanism of their color change.
8. Buffer and Isotonic Solutions: Buffer solution, buffer equations, buffers in pharmaceutical and biological systems, buffer capacity, isotonic, hypertonic and hypotonic systems, dialysis, methods of adjusting tonicity and pH.

Recommended Books:
1. M. M. Haque and M. A. Nawab : Principles of Physical Chemistry
2. A. Martin and J. Swarbrick : Physical Pharmacy
3. P.W. Atkins : Physical Chemistry

4. K.K. Sharma and L.K. Sharma : A Textbook of Physical Chemistry
5. B.S. Bahl, D.G. Tuli and A. Bahl : Essentials of Physical Chemistry
6. N. Kundu and S.K. Jain : Physical Chemistry
7. S. H. Maron and C.F. Prutton : Principles of Physical Chemistry

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-1
Course Title: Biochemistry and Molecular Biology
Course Code: PHARM 2106
Credits: 3

1. Enzymes: Nomenclature, chemistry, enzyme kinetics and its mechanism of action, mechanism of inhibition, isozymes and its clinical use, co-enzymes – vitamins as co-enzymes, chemistry of vitamins, their uses and significance, metals as co-factors and their significance.
2. Carbohydrates: The chemistry of carbohydrates, conversion of polysaccharides to glucose-1-phosphate, glycolysis and fermentation and their regulation, gluconeogenisis and glycogenolysis, metabolism of galactose and galactosemia, role of sugar nucleotides in biosynthesis and pentose phosphate pathways and other alternate pathway of carbohydrate metabolism.
3. The Citric Acid Cycle: Significance, reactions and energetics of the cycle, amphibiotic role of the cycle and glyoxalic acid cycle.
4. Lipids: The chemistry of lipids, oxidation of fatty acids, beta-oxidation and energetics, alpha-oxidation, omega-oxidation, biosynthesis of ketone bodies and their utilization, biosynthesis of saturated and unsaturated fatty acids, control of lipid metabolism, essential fatty acids and eicosanoids (prostaglandins, thromboxane), phospholipids, and sphingolipids.
5. Biological Oxidation and Redox Potential: The concept of free energy, determination of change in free energy from equilibrium constant reduction potential, bioenergetics, production of ATP and its biological significance. Enzymes and co-enzymes involved in oxidation reduction, its control, the respiratory chain, its role in energy capture, its control, energetics of oxidative phosphorylation, inhibitors of respiratory chain and oxidative phosphorylation and mechanism of oxidative phosphorylation.
6. Metabolism of Ammonia and Nitrogen Containing Monomers: Nitrogen balance, biosynthesis of amino acids, catabolism of amino acids, conversion of amino acids to specialized products, assimilation of ammonia, urea cycle, metabolic disorders of urea cycle, metabolism of sulfur containing amino acids, porphyrin biosynthesis, formation of bile pigments, hyperbilirubinemia, purine biosynthesis, purine neucleotideinterconversion, pyrimidine biosynthesis and formation of deoxyribonecleotides.
7. Nucleic Acids and Protein Biosynthesis: Brief introduction of the genetic organization of the mammalian genome, alteration and rearrangements of genetic material, biosynthesis of DNA and its replication, mutation, physical and chemical mutagenesis, carcinogenesis, DNA repair mechanism, biosynthesis of RNA, genetic code, components of protein synthesis and inhibition of protein synthesis, Regulation of gene expression.
8. Basic Principles of Molecular Biology.

Recommended Books:
1. A. L. Lehninger : Principles of Biochemistry

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-1
Course Title: Pharmaceutics-I- Lab
Course Code: PHARM 2107
Credit: 1

1. Preparation of percentage solution.
2. Preparation of aromatic water.
3. Preparation of syrup:
(a) Phenobarbitone-Na syrup
(b) Chlorpheniramine maleate syrup
(c) Promethazine HCl syrup
(d) Iron syrup
4. Preparation of suspension:
(a) Paracetamol suspension
(b) Antacid suspension
(c) Chalk powder suspension
5. Preparation of emulsion and determination of type of emulsion
(a) Primary emulsion by dry gum method and wet gum method.
(b) Castor oil emulsion.

B. Pharm Year 2: Seemester-1
Course Title: Pharmacology-I- Lab
Course Code: PHARM 2108
Credit: 1

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

B. Pharm Year 2: Semester-1
Course Title: Biochemistry and Molecular Biology-Lab
Course Code: PHARM 2109
Credit: 1

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

B. Pharm Year 2: Semester-2
Course Title: Pharmaceutical Inorganic Chemistry-II
Course Code: PHARM 2201
Credits: 3

1. Hematinic Preparations: Various types of iron and iron compounds, role of iron compounds in hematological crisis, official iron compounds.
2. Pharmaceutically Acceptable Glass and Glass Wires.
3. Water: Hardness of water, treatment of natural water- distilled water, demineralized water, and official waters.
4. Topical Agents: Official agents used in different dermatological conditions–protectives, antimicrobial agents- hydrogen peroxide solution, potassium permanganate, boric acid, iodine preparations, sodium hypochloride solution, protein precipitants, astringent products.
5. Gastrointestinal Agents: Classification of inorganic gastrointestinal agents, systemic and non-systemic antacids, preparation and application of antacids, preparation and application of adsorbents and saline cathartics or laxatives.
6. Dental Preparations: Dental plaque and antiplaque agents, dental caries, fluorides and other anticaries agents (preparation and application), dentifrices, mouthwash and desensitizing agents.
7. Radioactivity and Radiopharmaceuticals: Introduction, types of radiation and their properties, radioactive decay, half-life, average life, modes of radioactive decay, interaction of radiation with matter, measurement of radioactivity, radiation hazard and radiological safety, biological effects of radiation, control of radiation exposure, storage of radioactive materials, medical applications of radionuclides, official radioactive compounds and their importance, toxicity of radioactive isotopes, Contrast Media- Barium sulfate, organoidine compounds.
8. Miscellaneous Agents: Inhalants, respiratory stimulants, expectorants, emetics, antidotes, Pharmaceutical acids, bases, buffers, antioxidants, tabletting aids-lubricants, ligands, etc.
9. Large-scale Production of Selected Inorganic Pharmaceutical Active Ingredients: Sodium hydroxide, Aluminum hydroxide, Magnesium hydroxide, Ferrous sulfate, Plaster of Paris, activated charcoal, NaCl, KCl, $MgSO_4$ etc.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-2
Course Title: Pharmaceutical Organic Chemistry-II
Course Code: PHARM 2202
Credits: 3

1. A General Introduction of Heterocyclic Compounds: Characteristic, properties and pharmaceutical importance of heterocyclic compounds**:** furan, thiophene, pyrrole, quinoline, isoquinoline, pyridine, thiazole, imidazole, pyrimidine, indole etc.

2. Stereochemistry: A general treatment of different types of isomerism, tautomerism, asymmetric synthesis, Walden inversion and resolution of racemic mixture.

3. Reaction Mechanism:

a) Addition reaction: Electrophilic, nucleophilic and free radical (1, 2 and 1, 4) addition.
b) Substitution reaction: Unimolecular and bimolecular.
c) Elimination reaction: Unimolecular and bimolecular.
d) Rearrangement reaction: Hoffman, Claisen, Sigmatropic and Fries rearrangement.

4. Name Reactions: Arndt- Eistertd, Baklelite, Baeyer-Villiger, Birch reduction, Clemmensen reduction, Darzens condensation, Diels Alder, Eschweiler-Clarke, Friedel- Crafts, Gabriel synthesis, Gettermann- Koch and Sandmeyer, Grignard, Hofman, Mannich, Michael, Meerwin- Pondorf-Verley, Oppenauer oxidation, Perkin, Reformatsky, Reimer- Tiemann, Vilsmeier- Haack, Witting and Wolf-Kishner reduction.

5. Synthesis and Applications of Drugs: Paracetamol, aspirin, phenacetin, para-amino benzoic acid (PABA) and sulpha drugs.

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

7. Amino Acids and Proteins: General considerations, structure of amino acids, acidity and basicity of amino acids, isoelectric point, preparations and reactions of amino acids, essential amino acids, metabolism of amino acids-deamination, transamination, racimization etc.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-2
Course Title: Physical Pharmacy-II
Course Code: PHARM 2203
Credits: 3

1. Reaction Kinetics and Stability of Pharmaceuticals:
a) Chemical Kinetics: General consideration and concepts, rates and orders of reactions, methods for determination of orders of reactions, half life determination; factors affecting reaction rates - influence of temperature, humidity, light, solvent, catalytic species and other factors.
b)Physical Degradation of Pharmaceutical Products: Loss of water, absorption of water, loss of volatile constituents, polymorphism, color change.
c) Chemical Degradation: Hydrolysis, oxidation, isomerization, polymerization, decarboxylation, factors affecting chemical degradation etc.
d) Stability of Pharmaceuticals: Accelerated test for physical, chemical and photochemical stability, stability aspects of formulations, marketed products and clinical supplies, shelf life determination, expiration dating.
2. Surface and Interfacial Phenomenon: Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, adsorption at solid and liquid interfaces, complex films, electrical properties of interface, electrical double layer, Nernst and zeta potential, Gibb's equation, spreading, characteristics of adsorption, application of adsorption in pharmacy.
3. Surface-active Agents: Classifications of surfactants, emulgents, detergents and antifoaming agents, mechanism of actions and their uses in pharmacy.
4. Micrometrics and Powder Rheology: Particle size and distribution, Importance of particle size determination, average particle size, number and weight distribution, particle number, method of determining particle volume- optical and electron microscope studies, coulter counter methods, laser beam technique, sieve analysis, sedimentation methods; particle shape, specific surface, determination of surface area, permeability, derived properties of powder, porosity, packing arrangements, density, bulkiness and flow properties.
5. Viscosity and Rheology: Newtonian systems, Law of flows, basic equation of fluid flow, kinematics viscosity, effect of temperature, non-Newtonian system: pseudoplastic, dilatant and plastic flows, yield value, thixotropy, thixotropy in a formulation, determination of viscosity, measurement of flow and pressure and Reynolds number.
6. Colloids: Classification, preparation, electrical and optical properties, sedimentation, Stoke's law, stability of colloidal dispersion, protective colloid, sensitization, dialysis, Donnan membrane equilibrium, application and uses of colloidal preparation in pharmacy.
7. Electrochemistry:
a) Electrical units and their interrelation, Faradays laws of electrolysis and electrochemical equivalents, conductance of electrolytes, concept of E. M. F and its measurements, electrode, various types of electrochemical cells, relation between electrical and chemical energies, oxidation-reduction systems, solutions of electrolytes.
b) Electrochemical cells and cell reactions, electrode and cell potentials, energies involved in electrode processes; reference electrodes, concentration cell, stoichiometry of electrolysis, electrochemistry and biological cell potentials.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Seemester-2
Course Title: Applied Microbiology
Course Code: PHARM 2204
Credits: 2

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

2. Sterilization

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

b) Sterilization by filtration

c) Sterilization by radiation

d) Sterilization by gas

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

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

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

6. Immunological Products: Active antigenic products, attenuated, inactivated and extract, viral and bacterial products, passive products, gamma globulin.

7. Bacterial Resistance.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 2: Semester-2
Course Title: Pharmaceutical Inorganic Chemistry- Lab
Course Code: PHARM 2205
Credits: 2

1. Qualitative Analysis of Inorganic Ions and Radicals:
$Na^{+,}$ K^{+}, Ca^{+2}, Al^{+3}, Mg^{+2}, Fe^{+2}, Mn^{+}, Ag^{+}, Cu^{+} Cu^{+2}, Cl^{-}, Br^{-}, I^{-} and, CO_3^{-}, SO_4^{-2}, NO_3^{-}, PO_4^{-3} etc.
2.Identification of Inorganic Ions from Pharmaceutical Formulations: Ca^{+2}, Fe^{+2}, Al^{+3}, Mg^{+2}, K^{+} and Na^{+} ions from supplied preparations.
3. Conversion of Different Water Insoluble or Sparingly Soluble Drugs into Water Soluble Form:
a) Na/K-salicylate from salicylic acid.
b) Na/K-benzoate from benzoic acid.
c) Na/K-citrate from citric acid.
4. Preparation of Inorganic Drugs:
a) Preparation of aluminium hydroxide gel.
b) Preparation of magnesium hydroxide.
c) Preparation of haematinics- ferrous chloride, ferrous gluconate and ferrous fumerate.

B. Pharm Year 2: Semester-2
Course Title: Pharmaceutical Organic Chemistry- Lab
Course Code: PHARM 2206
Credits: 2

1. Detection of elements (C, H, N, O, F, Cl, Br etc)
2. Identification of functional groups (OH^{-}, CHO, NH_2, NO_3, CO, CHO, COOH, etc)
3. Test of purity

4. Solubility test and classification of the compounds.
5. Identification of organic compounds: Solids and liquids, detection and identification of impurities, tests for carbohydrates, proteins and fats.
6. Melting point determination of different unknown organic compounds.
7. Organic preparation involving typical rectionseg., Grignard reaction, Perkin reaction,Friedel craft reaction, esterification reaction.

B. Pharm Year 2: Semester-2
Course Title: Physical Pharmacy- Lab
Course Code: PHARM 2207
Credit: 2

1. Standardization of acids and bases.
2. Determination of pKaandpK_b values.
3. Preparation of solution of different pH & buffer capacity.
4. Determination of phase diagram of binary systems.
5. Determination of distribution coefficients.
6. Determination of mol. Wt. by Victor Meyer's method.
7. Determination of heat of solution by measuring solubility as a function of temperature.
8. Viscosity determinations:
a) Determination of viscosity of pure liquids such as glycerin, alcohol etc.
b) Determination of viscosity of liquid pharmaceutical preparation- syrup, emulsion, suspension etc.
c) Study of variation of viscosity of liquid with temperature using Ostwald or Engleris viscometer.
9. Determination of velocity constant of the hydrolysis of methyl/ ethyl acetate catalyzed by HCl/ NaOH.
10. Determination of adsorption isotherm of oxalic (or acetic) acid form aqueous solution by charcoal and calculation of the constant in Freundlich's equation.
11. Determination of the equilibrium constant of the reaction KI + I = KI_3.
12. Determination of solubility of a sparingly soluble salt in water by conductance measurement.
13. Determination of velocity constant for the hydrolysis of an ester in the basic medium by conductance measurements.
14. Determination of the molecular weight of an organic soli

B. Pharm Year 2: Semester-2
Course Title: Viva voce
Course Code: PHARM 2208
Credits: 1

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

B. Pharm Year 3: Semester-1
Course Title: Pharmaceutical Analysis-I
Course Code: PHARM 3101
Credits: 3

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

2. Titrimetric Analysis:

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

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

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

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

3. Aquametry: Principle and scope, physical methods of water determination, chemical method of water determination, Karl-Fischer procedure–principle, chemistry, methodology, equipment, end point detection and limitation.

4. Separation Technique:

a) Chromatographic Methods: Introduction, principles and theories, preparation, procedure, method of detection, applications of column chromatography, gel filtration techniques, thin layer chromatography, ion exchange chromatography.

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

5. Instrumental Methods of Analysis:

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

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

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

d) Gravimetric Analysis: Precipitation techniques, solubility products, the colloidal state, supersaturationalcoprecipitation, post precipitation, filtration techniques and filter papers, pharmaceutical importance of gravimetric analysis.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Medicinal Chemistry-I
Course Code: PHARM 3102
Credits: 3

1. Stereochemistry:

a) General treatment of different types of isomerisms.

b) Geometric isomerism of alkenes and cyclic compounds, cis, trans and (E), (Z) systems of nomenclature.

c) Conformational isomers- conformation of open chain and cyclic compounds.

d) Chirality of molecules- enantiomer, diastereomer, racemic modification, meso compound, (R) and (S) configuration, sequence rule, optical rotation.

e) Asymmetric synthesis- preparation of enantiomer by asymmetric synthesis and optical resolution method.

f)Stereoselective and stereospecific reaction.

g) Pharmaceutical importance of stereochemistry

h) Structure determination of vitamins, analgesics, steroids and terpinoids.

2. Heterocyclic Chemistry:

a) 5-membered heterocyclic compounds: Pyrrole, furan, thiophene, pyrazole, imidazole, oxazole, isoxazole, thiazole and Isithiazole- their preparations, reactions and pharmaceutical applications.

b) 6-membered heterocyclic compounds: Pyridine, piperidine, pyrimidine, pyradazine, pyrazine and triazine: their preparation- reaction and pharmaceutical applications.

c)Benzofused 5-membered heteroatomic compounds: Indole, benzofuran, benzothiaphene and carbazole- their chemistry, synthesis and pharmaceutical applications.

d)Benzofused 6-membered heteroatomic compounds: Quinoline and isoquinoline- their chemistry, synthesis and pharmaceutical applications.

3. Signal Transduction and Its Role in Designing Drugs.

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

a)Sedatives & Hypnotic agents: Benzodiazepines, Barbiturates.

b)Antihistaminics: H_1 and H_2 antagonists.

c) Analgesics and anti-inflammatory agents (NSAIDs): Indomethacin, Ibupropen, Naproxen and Probenecid.

d)Antipyretic Analgesics: Phenacetin, Phenylbutazone, Mefenamic Acid.

e)Cardiovascular Drugs: Hydralazine , Propranolol, Procainamide, Prenylamine.

f)Diuretics: Chlorothiazide , Acetazolamide , Triamterene.

5. Natural Products and Other Secondary Metabolites:

a) Vitamins: The clinical aspects of vitamins and their effects on free radicals; synthesis of vitamins such as Vit-B_1, Vit-C, nicotinamide, pyridoxine; mechanisms of the action of vitamins.

b) Alkaloids: Alkaloids as pharmaceutical raw materials, opium and analogues, synthesis of papaverine and ephedrine, clinical comparison of ephedrine and ephinephrine.

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Biopharmaceutics-1
Course Code: PHARM 3103
Credits: 3

1. Introduction to Pharmaceutics and Biopharmaceutics.

2. Gastrointestinal Absorption of Drugs:

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

b) Physicochemical Consideration: pKa and gastrointestinal absorption, pH-partition theory and other physicochemical factors.

c) Dosage form consideration: Role of different dosage form like solution, suspension. tablet, capsule, emulsion etc. on gastrointestinal absorption.

d) Diffusion and disintegration: Steady state diffusion, procedure & apparatus, transport of drug across GIT, diffusion controlled release- Higuchi's equation, diffusion principle in biological systems.

e) Dissolution of drugs: Dissolution rate, Hixson-Crowell Cube Root Law, factors influencing dissolution, dissolution test apparatus, in-vitro & in-vivo correlations of dissolution, drug release patterns.

3. Distribution of Drugs:

a) Important Pharmacokinetic Parameters: Biological half-life, apparent volume of distribution, area under the curve, absorption and elimination rate constant etc.

b) Interpretation of drug-plasma level curve.

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

4. Drug Clearance:

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

b) Renal Elimination: Glomerular filtration, active tubular secretion, tubular reabsorption. **c)** Determination of renal clearance.

d) Biotransformation of Drugs: Definition, drug biotransformation reactions, pharmacokinetics of drugs and metabolites (MichelisMenten equation), hepatic elimination, first pass effect, liver excretion ratio, relation between absolute bioavailability and liver excretion, hepatic clearance-relationship between blood flow, intrinsic clearance and hepatic clearance, hepatic clearance of a protein bound drug (effect of protein binding on hepatic clearance).

e) Biliary excretion of drug.

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

6.Drug Product Selection on the Basis of Bioavailability Testing.

Recommended Books:

1. Leon Shargel and Andrew B : Applied Biopharmaceutics and Pharmacokinetics
2. Milo Gibaldi : Biopharmaceutics and Clinical Pharmacokinetics
3. Donald E. Cadwallader : Biopharmaceutics and Drug action
4. Bourne, Triggs and Eadie : Pharmacokinetics for the Non-mathematical

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Pharmaceutical Biotechnology
Course Code: PHARM 3104
Credits: 3

1. Introduction of Biotechnology: History and different dimension of biotechnology, application of biotechnology in medicine, foods, forensic science, microbial and plant genetics.

2. Biophysical and Biochemical Analysis of Recombinant Proteins: Protein structure, protein folding, analytical techniques, approaches for rate controlled and target site specific delivery of proteinous drugs.

3. Fermentation Technology:Introduction to fermentation technology, improvement of industrial strains of microorganisms, fermentative, medium and inoculum development, biological products obtained from fermentation.

4. Recombinant DNA Technology and Production of Biotech Compounds: Basic principle, genetic recombination- cloning, gene expression, restriction endonuclease, ligase and other enzymes used in gene cloning, cloning vectors, transfection method, knock out and transgenic animals, cultivation and downstream processing, issues to consider in production and purification of proteins.

5. Formulation of Biotech Products: Microbiological considerations, excipients used in parenteral formulations of biotech products, routes of administration and absorption enhancement, stability, bioavailability and designing drug delivery systems for biotechnological products.

6. Immunolgy: Monoclonal antibody, hybridoma technology, basic principles of immunology, antigen and haptens, vaccines.

7. Gene Therapy: Ex vivo versus in vivo gene therapy, potential target diseases for gene therapy, gene transfer methods, and non-viral gene transfer.

8. Pharmaceutical Production: Short study of current biotech products- Interleulins and interferons, insulin, vaccines, monoclonal antibody-based pharmaceuticals, follicle stimulating hormone (FSH), trustuzumab; dispensing of biotechnology products- storage temperature requirements, storage in dosing and administration devices, light protection, handling, mixing and shaking, shipment requirements, preparation and administration.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Pharmaceutical Product Development
Course Code: PHARM 3105
Credits: 3

1. Manufacturing Practice: GMP, Total Quality Management and Quality Assurance, Quality Audit.

2. Pharmaceutical Operations: Design, development and process validation methods for pharmaceutical operations.

3. Preformulation Studies: Study of physical properties of drug: physical form, particle size, shape, density, wetting, dielectric constant, solubility, dissolution & organoleptic property & their effects on formulation, stability & bioavailability, study of chemical properties of drug: hydrolysis oxidation, reduction, raceamization, polymerization etc., & their influence on formulation & stability of products, study of prodrug in solving problems related to stability, bioavailability, palatability & elegancy of formulation.

4. Performance Evaluation Methods: In vitro dissolution studies, methods and interpretation of dissolution data.

5. Stabilization and Stability Testing: Stabilization and stability testing protocol for various pharmaceutical products.
6. Plant Design: Design of a pharmaceutical manufacturing plant in keeping with cGMP guidelines.
7. Packaging of Pharmaceutical Products: Packaging components, types, specification & methods of evaluation, stability aspects of packaging, packaging equipment, factors influencing choice containers, uqal& other factors influencing choice of containers, uqal& other official requirements for containers, package testing.
8. Sustained Release: Design, development, production, components and evaluation of controlled release formulation.
9. Special Drug Delivery Systems: Transdermal drug delevary system etc.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Environmental Sciences and Control
Course Code: PHARM 3106
Credits: 3

1. Water Resources, Quality and Control: lakes, streams, oceans and ground water, elements of fluid dynamics of surface and ground water, waste water, sources and pollution, water treatment processes, river water monitoring, control and cleanup methods.
2. Control of Air and Noise Pollution: Classification of pollutants and sources, description of noise pollution.
3. Control of Solid Wastes: Definition, Classification of Solid wastes, domestic, industrial and hazardous and waste disposal.
4. Environmental Conservation and Sustained development: Policies and strategies of sustainable development, sustainable natural resources management and biodiversity management.
5. Environmental Microbiology and Biotechnology: Microorganisms in nature, Microbial biodiversity and bioremediation.
6. Environmental Health and Toxicology: Toxicology of metal pollutants, Non metal pollutants and air pollution effects on the respiratory system.
7. Environmental Impact Assessment (EIA): Relation between development and environment, comparison between economic and ecological criteria, Relation between EIA and sustainable development.

Recommended Books:

1. Prof. SubhasSantra : Environmental Science.
2. Atlas &Bartha : Microbial Ecology
3. Wright &Wellbourn : Environmental toxicology.

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-1
Course Title: Pharmaceutical Analysis-I- Lab
Course Code: PHARM 3107
Credit: 1

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

B. Pharm Year : Semester-1
Course Title: Medicinal Chemistry-I- Lab
Course Code: PHARM 3108
Credit: 1

Laboratory synthesis, physical, chemical and spectral characterization of the following Compounds:
1. Paracetamol
2. Benzocaine
3. Aspirin
4. Phenacetin
5. PABA (para amino benzoic acid)
6. Meta nitro benzaldehyde
7. Ethyl para hydroxy benzoate
8. Para amino phenol
9. Methyl salicylate.

B. Pharm Year 3: Semester-2
Course Title: Pharmaceutics -II
Course Code: PHARM 3201
Credits: 3

1. Formulation and Manufacturing of Tablets: Advantages and classification of tablets, formulation and granulation of powders for tableting, manufacturing of tablets by wet granulation, dry granulation and by direct compression, different types of tablet compression machinery and equipment.

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

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

4. Tablet Coating: Definitions and classification of coating methods, advantages and disadvantages of coated tablets, different methods of coating- sugar coating, different stages of sugar coating, problems of sugar coating; film coating- theory of film coating, film formers, plasticizer, solvents, other excipients; enteric coating- enteric coating polymers, formulations of enteric coating, dry coating (compression coating), comparison between sugar coating and film coating, aqueous film coating techniques, modern film coating materials and coating formulations, problems of organic and aqueous film coating; coating machines: conventional coating machines, perforated coating machines, fluidized coating machines.

5. Capsules:

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

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

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-2
Course Title: Pharmacology-II
Course Code: PHARM 3202
Credits: 3

1. Autacoids:

a) Histamines: Mode of action, action on cardiovascular system, smooth muscle, gastric secretion, anaphylactic shock, histamine-releasing drugs, allergic disorder.

b) Antihistamines: Classification, pharmacological, therapeutic uses, absorption, distributions, excretion, adverse reactions, etc.

c) Serotonin and serotonin antagonists: Occurrence, pharmacological action, serotonin antagonist, prostaglandins, prostacyclins and tHouromboxane.

d) The kinins: Kallidins and bradykinin.

2. Analgesic, Antipyretic and Antinflammatory drugs:

a) Non-narcotic analgesic- salicylates, pyrazolone derivatives, para-aminophenol derivatives, propionic acid derivatives, indomethacin, sulindac, tolmetin, diclofenac;

b) Narcotic analgesics - opium alkaloids, morphine antagonists, synthetic & semisynthetic opiates.

3. Antibacterial Agents: Introduction, classification, mode of action, structure-activity relationship. Brief study of the following class of drugs

a) Drugs affecting folate synthesis- sulfonamide, trimethoprim

b) β-lactam antibiotics-penicillin,cephalosporin.

c) Drugs affecting protein synthesis- tetracycline, chloramphenicol, macrolides, aminoglycosides.

d) Drugs affecting Topoisomerase-I enzyme- fluoroquinolones.

e)Glycopeptide, polymyxin, bacitracin &nitrofurantoin antibiotics.

f)Antitubercular agents- Isonizid, rifampicin, ethambutol, pyrazinamide, PAS, capreomycin, cycloserine, ethionamide.

g)Antileprotic drugs- dapson, rifampicin, clofazimine.

4. Cardiovascular Drugs: Introduction, classification, mechanism of action, SAR studies of:

a) Antihypertensive drugs

b) Antiarrhythmic drugs

c) Diuretics

d) Drugs used in heart failure

e) Drugs used in angina and myocardial infarction

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

6. Anesthetics: Introduction and classification.

a) Local anesthetics: History, mechanism of action, properties, SAR, pharmacological action, fate, ester and amide type local anesthetics.

b) General anasthetics. (i) Inhalation anasthetics: nitrous oxide, halothane, enflurane, isoflurane&sevoflurane (ii) Intravenous anesthetics: barbiturates, benzodiazepines & opioid analgesics, propofol, ketamine.

7. Drug Acting on ANS:

a) (i) Parasympathomimetic agents: Acetyl choline, Methacoline, Carbachol. (ii) Sympathomimetic drugs: Epinephrine, norepinephrine. (iii) Anticholinesterase agents: Physostignine, Edrophonine. Organophosphorous compounds.

b) (i) Antimuscarinic Agents or Atropine Drugs: atropine sulfate, scopolamine hydrobromide, homatropinehydrobromide. (ii) Drugs inhibiting adrenergic nerves and structures innervated by them, adrenergic blocking agents.

c) Ganglion Stimulating and Blocking Agents.

8. Drugs Affecting Renal Function: Osmotic diuretics, carbonic anhydrase inhibitors, potassium sparing diuretics, high ceiling diuretics.

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-2
Course Title: Biopharmaceutics-II
Course Code: PHARM 3203
Credits: 3

1. Compartmental Analysis: Introduction:

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

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

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

3. Multiple Dosage Regimen (MDR): Drug accumulation, repetitive intravenous injection, multiple oral dosage regimens, loading dose and determination of bioavailability and bioequivalence from MDR.

4. Intravenous Infusion: One-compartment model drugs, two-compartment model drugs, infusion plus loading dose.

5. Dosage Adjustment in Renal Disease:

a) Pharmacokinetic considerations, general approaches for dose adjustment in renal diseases, dose adjustment based on drug clearance, dose adjustment based on the elimination rate constant, measurement of glomerular filtration rate (GFR), calculation of creatinine, clearance from serum creatinine concentration, dose adjustment based on nomogram, Giusti-Hayton method, Wagner method.

b) Extracorporeal removal of drugs.

6. Non-compartmental analysis: Physiologic-pharmcokinetic model, statistical moment, mean residence time etc.

7. Relationship between pharmacokinetic and pharmacologic responses.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-2
Course Title: Clinical Pathology
Course Code: PHARM 3204
Credits: 3

1. Definition and Scope of Pathology: Concept of diseases, General considerations, core and scope of basic and clinical pathology.

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

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

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

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

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

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-2
Course Title: Pharmaceutical Marketing and Management
Course Code: PHARM 3205
Credits: 3

A. Pharmaceutical Marketing

1. Basics of Marketing: Needs, wants and demands; product, value, cost, satisfaction; exchange, transaction and relationship; markets, marketing and marketers.

2. Production, Product, Selling and Marketing Concepts: Marketing process- selecting marketing opportunities, targeting the market, product positioning, formulating marketing strategy and plans, organizing, and implementing and controlling marketing efforts.

3. Pharmaceutical Marketing Environments: Patients- disease incidence, economic factor, demographic factor, physician- different classes, hospital and clinic, retail and wholesale pharmacy, competitive factors, social and cultural factors, technology, government and legal factors.

4. Identification of Marketing Opportunity: Marketing Information System, prescription audit, prescription behavior analysis, doctors' database, purchase invoice audit, prevalence of diseases, identifying competitors, identifying competitors' strategy, objectives, strengths and weaknesses, reactions.

5. Demand Analysis: Market potential, estimating market share, forecasting techniques- expert opinion, seasonal variation, statistical techniques, trend extrapolation, survey of prescribes' opinions.

6. Market Segmentation: Necessity of market segmentation, prescription market-group of doctors, therapeutic market, OTC market, wholesale market, and government market, clinics, NGOs, foreign market.

7. Formulation of Marketing Strategies: Establishing competitive edge, product differentiation, service differentiation, product positioning, medical treatment problems.

8. New Product Launches: Screening, business and medical analysis, organizing launching program, coordination with regulatory affairs department, manufacturing, purchasing, packaging design & pricing, advertising agency, training the sales personnel, and post marketing surveillance.

9. Product Life Cycleof Pharmaceutical Products: Marketing strategies in different stages, marketing strategies of market challengers, market followers, market leaders.

10. Marketing Program: Product mix decisions, product line decision, five product levels, setting the price- controlled, decontrolled; managing the channel of distribution, managing the sales force-training, fixation of objectives, usage of promotional materials, finding target doctor, call frequency, professional sales call, model of sales call, post call analysis, motivating sales force.

11. Product Mix Strategies: Promotional tools- literature for detailing, prescription pad, sample, direct mailing, doctors' meeting, medical journal article, journal advertising, gimmicks, trade promotion. Designing effective promotional programmed-setting promotional objectives, the

positioning message, appealing message for doctors, media and frequency of communication, budget, components of literature; measurement of effectiveness of communication.

B. Pharmaceutical Management

1. Managerial Role of Pharmacists: Pharmacists in different services of health and pharmaceutical industry- pharmaceutical production and quality control, marketing and sales, regulatory affairs, training, medical information services, research and development, hospital pharmacy, community pharmacy, NGOs, education consultancy.

2. Management: Nature and purpose of management, managerial function, role and skill; social responsibility and ethics of pharmaceutical managers.

3. Planning: Nature, types of plans, planning steps and processes, decision making in different environments.

4. Organizing: Process of organizing, organizational structure, line and staff concepts, delegation.

5. Staffing: Recruitment process and technique, training and development.

6. Leading: Leadership, its style and qualities, human factor in managing, motivation- theories and techniques. Communication processes, techniques and barriers.

7. Controlling-Basic Control Process, critical control points and standards.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 3: Semester-2
Course Title: Pharmaceutics-II- Lab
Course Code: PHARM 3206
Credit: 1

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

8. Formulation and manufacturing of some capsule dosage form.

B. Pharm Year 3: Semester-2
Course Title: Pharmacology-II- Lab
Course Code: PHARM 3207
Credit: 1

1. Estimation of blood glucose by enzymatic method.
2. Estimation of blood glucose by chemical method.
3. Estimation of aspirin in blood after oral administration by UV spectrophotometric method.
4. Estimation of aspirin in blood after oral administration by colorimetric method.
5. Estimation of plasma protein by enzymatic method.
6. Estimation of plasma protein by Biuret method.
7. Estimation of blood uric acid level by enzymatic method.
8. Estimation of paracetamol in blood after oral administration by UV/Visible spectrophotometric method.
9. Handling of experimental animals: mice and rat.
10. Different routes of administration of drugs in experimental animals.

B. Pharm Year 3: Semester-2
Course Title: Biopharmaceutics- Lab
Course Code: PHARM 3208
Credits: 2

1. Tablet weight variation test.
2. Tablet hardness test.
3. Tablet friability test.
4. Disintegration test for film coated tablets.
5. Disintegration test for capsules.
6. Dissolution test for immediate release tablets.
7. Dissolution test for capsules.
8. Leakage test of packaging of tablets/capsules.
9. Capsule weight variation test.
10. Determination of viscosity and specific gravity of different syrups.
11. Determination of viscosity of different suspensions.
12. Determination of the dissolution time and dissolution rate of the enteric coated diclofenac sodium tablet.
13. Determination of drug release time from enteric coated tablet.
14. In vitro dissolution study of theophylline tablet.
15. In vitro dissolution study of SRDF theophylline capsule.
16. Preparation of castor oil emulsion and determination of its pH and viscosity.
17. Determination of drug release time of different suppositories.
18. Determination of drug content in ointments.
19. Determination of drug content in creams.
20. Determination of drug content in O/W and W/O emulsions.

21. Determination of drug content in suspensions.
22. Determination of drug content in dry syrups.

B. Pharm Year 3: Semester-2
Course Title: Viva voce
Course Code: PHARM 3209
Credit: 1

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

B. Pharm Year 4: Semester-1
Course Title: Pharmaceutical Analysis-II
Course Code: PHARM 4101
Credits: 4

1. Nuclear Magnetic Resonance Spectroscopy: ^{1}HNMR spectroscopy: Introduction and theory, relaxation process, instrumentation, chemical shift, spin-spin coupling, different spin systems, coupling constants, spin-spin decoupling, long range coupling; Two dimensional NMR spectroscopy, nuclear over hauser effect, 2D correlated (COSY) and 2D Nuclear over hauser enhancement spectroscopy (NOESY), HMBC, HMQC.
2. ^{13}CNMR Spectroscopy: Introduction, principle, chemical shift, spin-spin coupling, applications.
3. Mass Spectrometry: Introduction, theory, the mass spectrum, recognition of molecular ion, isotopic peaks, ionization techniques- electron impact, chemical ionization, fast atom bombardment etc.; fragmentation pattern; aliphatic and aromatic hydrocarbons, alcohols, ethers, aldehydes, ketones, acids, esters, amides etc.; analyzing techniques-magnetic sector, quadrupole; determination of molecular formula, applications of mass spectrometry.
4. Infrared (IR) Spectroscopy: IR absorption process, methods of vibration and bending, bond properties and absorption trends, IR spectrophotometer, approaching the analysis of a IR spectrum, use of IR spectrum.
5. Gas Chromatography: Introduction and principles, theoretical consideration, column technology, detectors, analytical application of gas chromatography.
6. Atomic Absorption Spectroscopy: Theory, instrumentation and application in quantitative analysis.
7. Potentiometric Titration: Introduction, theory and principles, electrochemical cells and half-cells, electrodes, measurement of potential, application of potentiometric titration.
8. Polarography and Amperometric Titration: Introduction, theoretical considerations, instrumentation, general polarographic analysis, amperometric titration using one and two electrodes.
9. X-ray Crystallography: Generation and properties of X-ray, diffraction of X-ray by crystals, , Bragg's equation, X-ray diffraction methods, powder diffraction patterns, methods of measurement, analysis, indexing of X-ray reflections and determination of space groups, Fourier and Patterson syntheses and application of X-ray diffraction.
10. Microbiological Assay of Antibiotics: Introduction, reference standard and units of activity, agar diffusion assay, theory of zone formation, factors affecting agar diffusion assay, dose response curve, large plate assay using Latin square design, statistical interpretation of microbiological assay results.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-1
Course Title: Medicinal Chemistry-II
Course Code: PHARM 4102
Credits: 3

1. Drug Design and Discovery:

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

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

c)Drug Development: Objectives, Pharmacophore, Patterns and SAR of drug development from natural sources, Modification synthetic analogues (Variation of Substituents, Bioisosterism, Homologation, Chain Branching and Ring variation).

d)Drug Design for Pharmacokinetcs Problems: Metabolic blockers, Prodrugs, Sentry drugs, 'Search and destroy' drugs, Self-destruct drugs, Drug distribution and survival of drugs.

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

2. Combinatorial Chemistry and Rapid Parallel Syntheses:

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

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

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

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

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

a)Antidiabetic drugs

b)Antineoplastic drugs: Alkylating agents, Antimetabolites, Plant products.

c)Psychotropic drugs and antidepressants :TCA compounds, MAOIs, Phenothiazine derivatives.

d)Semisynthetic penicillins, cephalosporins, and quinolone derivatives

e)Antimalarials: Chloroquine, Pamaquine, Trimethoprim.

f)LocalAnaesthetics: Benzocaine, Procaine, Lignocaine.
g) Non-steroidal Oestrogens: Stilbesterol, Hexestrol, Dienestrol.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Seemester-1
Course Title: Drug and Disease Management-I
Course Code: PHARM 4103
Credits: 3

1. Calculation of Creatinine Clearance for a Patient and Classification of Their Degree of Renal Impairment: Identification of two drugs which have active metabolites that are renally eliminated, identification of six drugs for which the dose should be reduced in renal impairment and study about the clinical consequences of not reducing the dose, hepatic disease that may affect the disposition and pharmacokinetics of drugs, identification of the most useful indicators to monitor hepatic function, recommendations on how to choose drugs and/or adjust doses in patients with hepatic disease.

2. The Role and Limitations of Therapeutic Drug Monitoring (TDM) in Individualizing Drug Therapy: Identification of five drugs for which TDM may contribute to optimization of therapy, identification of three parameters which need to be identified in order to ensure appropriate use of TDM.

3. Drug Delivery & Administration for Each of the Following Routes of Administration: The drug formulations commonly given by that route, the key biopharmaceutical and therapeutic considerations integral to the route of administration, a clinical condition or situation in which this may be the preferred route; oral, sublingul, buccal, parenteral; including intravenous, intra-articular, intradermal, intramuscular, subcutaneous, topical, transdermal, inhalation, intracular, intranasal, inhalation.

4. Adverse Drug Reactions: Definition of an adverse drug reaction (ADR), tHouree key difference between type A and type B ADRs, six factors which may contribute to the development of an ADR, the six most common clinical manifestations of ADRs, for each of the following; two clinical syndromes and two common causative agents.

a) drug-induced hepatic disease
b) drug-induced renal disease
c) drug-induced skin disorder
d) drug-induced hematological disorder

5. Drug Interactions: Six pharmacokinetic mechanisms by which interactions may occur, giving a clinical example of each; three pharmacodynamic mechanisms by which interactions may occur,

giving a clinical example of each two examples of a drug-food interaction; two examples of a drug alcohol interaction, one example of a drug-tobacco interaction.

6. Asthma: Aetiology and pathogenesis of asthma, treatments for acute and cHouronic asthma, factors influencing the choice of drug, dose, formulation and route of administration; monitoring the beneficial and adverse outcomes of drug therapy asthma.

7. Chronic Obstructive Pulmonary Disease (COPD): Aetiology and pathogenesis of COPD; treatment of COPD; complications of COPD and their management; factors influencing the choice of drug, dose, formulation and route of administration; monitoring the beneficial and adverse outcomes of drug therapy for COPD.

8. Pharmaceutical Care in Respiratory Disease: How pharmacists identify patients with undiagnosed asthma or COPD (chronic obstructive pulmonary disease); the role of the pharmacists in smoking cessation; choices of device available to deliver treatments; methods by which patients with asthma or COPD should be monitored; pharmacists' role in the provision of oxygen therapy for COPD; problems which may lead to treatment failure.

9. Management and Treatment of Different Psychiatric Disorders including depression, anxiety, manic disorder, panic disorder, OCD, schizophrenia and others, management and treatment of drug abusive patients.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-1
Course Title: Clinical Pharmacy
Course Code: PHARM 4104
Credits: 4

1. Introduction and Basic Concepts: Clinical Pharmacy and therapeutics, History, its scope and definitions.

2.Drug Use in the Health Care System: Problems occurring with the use of drugs: self-medication, Compliance Issues, drug use by the elderly, impacting the problems of drug use: medication errors, the epidemic of prescribed drug abuse.

3. Drug Information & Literature Evaluation: Library orientation and use of on-line data bases, protocol for handling a request: Systematic approach, types of references, classification of requests, protocol for evaluating a study from the primary literature, establishing a drug information filing system, medical terminology self-study.

4.Guidance for Special Clinical Practices: Neonates, children, elderly, terminal care, liver disease, renal impairment, pregnancy and lactating mothers.

5.Pharmacotherapy Principles for Geriatric Patients: Sociodemographics, health status, age-related changes, drug-related problems, geriatric assessment, drug therapy monitoring, documentation, patient education, ambulatory geriatric clinic, long-term care, patient care and monitoring.

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

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-1
Course Title: Pharmaceutical Finance Affairs
Course Code: PHARM 4105
Credits: 4

1. Finance Function: Nature and scope, general organization structure for finance function.
2. Financial Decision Making: Wealth maximization, time value of money and discount rate, risk return trade off, capital budgeting decision in risk and uncertainty.
3. Financial Management: Role, objectives and goals, functions, financial policy, financial problem handling.
4. Money and Inflation: Theory of money & inflation, supply and demand of money. Value for money in the future of medical care.
5. Valuation: Loan, interest, risks and returns. Hospitals and Cost Functions.
6. Financial Plans and Analysis: Balance sheet and financial statements, fund analysis, forecasting plan.
7. **Capital**: Working capital, capital structure determination, long term debts, structuring liability, investment, project valuation, developing cash flow data,
8. Investment: Project development cycle, feasibility study of a project, determinants of investments, inventory investment, investment policy, evaluation techniques. Dynamics of national health spending and employment.
9. International Trade Transactions: Structuring international trades**,** management of exchange rate risk exposures, international flows of capital and pharmaceuticals.
10. Asset-liability Management: Strategies, interest rate risks, challenges of liability management.

Recommended Books:

1.Fundamentals of Financial Management – James C. Van Horne & John M Wachowicz.
2.Bank management & Financial Services – Peter S. Rose & Sylvia C. Hudgins.
3.Macroeconomics- N. Gregory Mankiw
4.Financial Management Policy by James C. Van Horne.
5.Principles Managerial Finance by Gitman
6.Principles of Corporate Finance by Richard A. Stewart.

7.Financial Markets and Institutions by Madura.
8.Financial Theory and Corporate Policy by Copeland, Weston.
9.Financial Institutions Management by Saunders.
10. Financial Accounting by Weygandt, Kieso, Kimmel.
11. Projects Planning, Analysis, Selection, Financing, Implementation and Review by Prasanna Chandra
* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Seemester-1
Course Title: Hospital and Community Pharmacy
Course Code: PHARM 4106
Credits: 3

1. Introduction to Hospital Pharmacy: Goals, minimum standards, abilities required for a hospital pharmacist, hospital as an organization, classification, organizational patterns, management and administration, different departments and services, role of a pharmacist in the hospital, hospital pharmacy, organizational and personnel, supportive personnel, pharmacy education, job description.
2. Pharmacy and Therapeutics Committee: Description and purpose, membership and functions, hospital formulary, guiding principles, legal basis, principles for admission or deletion of drugs, selection of text, investigational use of drugs, description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.
3. Purchasing and Inventory Control: Purchasing agent, purchasing procedure, control on purchase, storage, perishable inventory, physical inventory, perpetual inventory.
4. Control of Special Classes of Drugs: Use of samples, in-patient drug orders, out-patient prescriptions, ward stock drugs, label symbols, narcotics and their control, classes, procurement and execution of order forms, dispensing, hospital narcotic regulations, new systems, floor stock drugs, selection, charge and non-charge, labeling, regulations concerning narcotics, inspection of nursing drug cabinets.
5. Dispensing to In- and Out-patients: Drug distribution systems, dispensing of charge, non-floor stock drugs, mobile dispensing unit, unit dose dispensing, new concepts, dispensing to out-patients, locality of out-patient dispensing area, dispensing routine, record keeping, dispensing during off-Hours, use of nursing supervisors, emergency boxes and night drug cabinets, pharmacist-on-call, drug charges in hospitals, pricing, break-even point pricing.
6. Manufacturing–Bulk and Sterile: Control and budget, manufacturing facility and capacity, operating costs, quality control.
7. Drug Information Center and Library
8. Community Pharmacy: Concept of community health care, health needs of the community, different level of health care, elements of primary health care, principles of primary health care: equitable distribution, community participation, intersectoral coordination, appropriate technology, health manpower, health care delivery at different levels, community pharmacy in dealing with communicable diseases problem, nutritional problems, environmental sanitation problems and indigenous systems of medicine, development of community pharmacy infrastructure, participation of non-governmental voluntary health agencies.
9. Rational Use of Drugs: Background of rational use of drugs, definition, factors underlying irrational use of drugs: patients, prescribers, drug supply system; drug regulation and drug promotion, impact of irrational use of drugs with examples, disease-specific indicators, drug use patterns in developing countries, changing drug use patterns, factors effecting drug use, strategies to improve prescribing, experiences with interventions to change drug use in developing countries, strengths and

weaknesses of different interventions to change drug use patterns, international network for rational use of drugs.

10. Forensic Pharmacy: Definition, epidemiology of poisoning, influential factors, substances most frequently involved in accidental ingestions among children, first-aid treatment for poisoning, treatment, antidotes: locally acting and systemic, prevention of poisoning, poison control, poison control act, schedules, poison treatment centers, poison prevention packaging, national and community awareness, centralization of poison information, role of pharmacist at different levels.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-1
Course Title: Pharmaceutical Analysis-II- Lab
Course Code: PHARM 4107
Credit: 1

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

B. Pharm Year 4: Semester-1
Course Title: Medicinal Chemistry-II Lab
Course Code: PHARM 4108
Credit: 1

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

1. Esomeprazole.

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

B. Pharm Year 4: Semester-2
Course Title: Pharmaceutics-III
Course Code: PHARM 4201
Credits: 4

1. Sustained Release Drug Delivery Systems: Definition, advantages and limitations of SR dosage forms, principle of SR dosage forms, classification and types of SR dosage forms, methods of obtaining SR effects of drugs, formulation and manufacturing of SR matrix tablets, release mechanism of drug, sustained action oral liquids, parenteral sustained action dosage form, dose calculation for SR dosage forms, in vitro and in vivo evaluation of sustained action dosage form.
2. Special Drug Delivery System: Transdermal therapy, ophthalmic preparation etc.
3. Design and Operation of Clean Rooms: Source of contamination, classification of clean rooms, airflow systems- conventional flow, unidirectional flow, laminar airflow units; air filtration mechanisms, fibrous filters and HEPA filters, temperature and humidity control, building design, construction and use, personnel, protective clothing, cleaning and disinfection, commissioning tests of clean and aseptic rooms, routine monitoring tests, the operation of clean and aseptic rooms, key factors in clean room operations.
4. Parenteral Products: Definition and classification of parenteral products, formulation considerations-
a) Pre-operational factors, water for injection, pyrogenecity, non-aqueous vehicles, isotonicity and methods of its adjustment.
b) Formulation techniques, containers and closures and their selection.
c) Prefilling treatments, washing of containers and closures, preparation of solutions and suspensions, filling and closing of ampules, vials, infusion fluids, lyophillization and preparation of sterile products, equipment for the manufacture of sterile products.
d) Methods of maintaining sterility.
e) Evaluation of parenteral products by instrumental and biological methods, LAL test and pyrogen testing.
5. Blood Products and Plasma Substitutes: Collection, processing and storage of; whole human blood, concentrated human RBC, dried human plasma, human fibrinogen, human tHourombin, human normal immunoglobulin, human fibrin foam, plasma substitutes, ideal requirements, PVP, dextrin, etc., control and/or maintenance of blood pressure.
6. Ophthalmic Products: Anatomy of eye and adrena, absorption of drugs in the eye, classification of ophthalmic products, safety considerations of ophthalmic products, formulation, vehicles and

additives, manufacturing considerations, environment, manufacturing techniques, quality control of ophthalmic products, packaging of ophthalmic products.

7. Aerosol Science and Technology: Definition and classification of aerosols, propellants for aerosol manufacturing, components of aerosol formulations, containers and valves for aerosols, metered dose delivery of aerosols, manufacturing of aerosols, testing and quality assurance of aerosols.

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

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Seemester-2
Course Title: Pharmacology-III
Course Code: PHARM 4202
Credits: 4

1. Immonosuppressive Agent and Gene Therapy: Cytotoxic drugs, glucocorticoids, antibodies, specefic T-cell inhibitors, gene modification, gene transfer, application.

2. Antineoplastic Drugs: Alkylating agents, antimetabolites, vinca alkaloids, taxanes antibiotics, cisplatin, carboplatin, etoposide.

3. Antiviral Drugs: Anti-herpes virus, antiretro virus, anti-influenza virus, nonselective antiviral drugs.

4. Psychotropic and Antidepressant Drugs: Classification, mode of action, SAR, pharmacological actions, indications, toxicities and contraindications of chlorpromazine, benzodiazepam, TCA, MAO inhibitors, etc.

5. Antiepileptic Drugs: Phenytoin, primidone, phenobarbitone, mephobarbitone, carbamazepine, valproic acid, lamotrigine, vegabatrin, benzodiazepines, trimathadone, gabapentin, types of seizures.

6. Drugs Affecting Uterine Contraction: Oxytocin, prostaglandin, ergot alkaloid, tocolytics.

7. Antifungal Drugs: Amphotercin B, flucytosine, itracouzale, ketoconzole, fluconazole, nystatin, griseofulvin.

8. Hormones: Biochemistry and mode of action of hormones, Hormones as drugs.

9. Enzymes in Therapy: General properties of enzymes and their mode of actions, activators, inhibitors and cofactors, enzymatic basis of drug action, enzymes of pharmaceutical importance, their production, preparation, formation, use and assay methods.

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

11. Pharmacological Studies of Various Groups of Drugs:

a) Drugs used in the treatment of tuberculosis: (i) Chemotherapeutics: INH, para-aminosalicylic acid, ethambutol, pyrazinamide, etc. (ii) Antibiotics: gentamicin, rifampicin, streptomycin, etc.

b) Cholinergic and anticholinergic drugs.

c) Adrenergic and antiadrenergic drugs.

d)Antidiarrhoeal agents: ORS, tetracycline, streptomycin, sulfonamide, loperamide and spasmodic drugs, etc.

e) Anti-fertility drugs: Oral contraceptives, mechanical barriers, implants, foams, etc.

f) Drugs used in Acquired Immune Deficiency Syndrome (AIDS)

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-2
Course Title: Cosmetology
Course Code: PHARM 4203
Credits: 3

1. The Skin: Introduction, epidermis and keratinizing system, pigment system, langerhans cell, dermis, nerves and sense organs, blood vessels, exocrine sweat glands, hair follicles, sebaceous glands, apocrine glands, common disorders of the skin.

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

3. The Manufacture of Cosmetics: Introduction, mixing and the manufacture of bulk cosmetic products, solid-solid mixing, manufacture of pigmented powder products, mixing processes involving fluids, general principles of fluid mixing, mixing equipments for fluids, solid-liquid mixing, suspension of solids in agitated tanks, liquid-liquid mixing: miscible liquid, immiscible liquid.

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

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

6. Dental Products: Introduction, dentrifrices, formulation and manufacturing of toothpastes and tooth powders, mouth wash, oral rinses.
7. Hair Products: Introduction, shampoos, hair setting lotions, hair tonics and conditioners.

Recommended Books:

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

*Other Books will be indicated by respective teachers.

B. Pharm Year 4: Seemester-2
Course Title: Pharmacoeconomics and Policy
Course Code: PHARM 4204
Credits: 4

1. Understandings of how the market for pharmaceuticals works and why it is often the focus of much regulation, flow of funds, demand, contracting.

2. Nature and content of a marketing plan, executive summary, current marketing situation, opportunity and issue analysis, objectives, marketing strategy, action program, projected profit-loss statement, control.
3. Modern Pharmaceutical organization, evolution of pharmaceutical marketing, responsibilities of product management, documentation for ISO 9000, ISO 9001, marketing planning, marketing research, medical services, training, regulatory affairs, product development, international marketing-export, import; sales departments.
4. Economic and policy problems encountered in managing pharmaceutical markets and how to evaluate the impact of alternative policy approaches, basic features of pharmaceutical markets; approaches to regulating the market; and critically evaluating the impact of policy on market outcomes.
5. Code of pharmaceutical marketing, future of Pharmaceutical marketing- effect of GATT; change in drug policy, development of genetic engineering, changes in health habit and awareness, introduction of health insurance.
6. Analyses of pharmaceutical markets from the perspectives of several main factors- governments, third party payers, the pharmaceutical industry, doctors, patients, pharmacists and wholesalers.
7. Fundamentals to decision making of pharmaceutical economic agents such as business firms, macroeconomics, consumers and government.

Recommended Books:

1. Thomas E. Getzen : Health Economics: Fundamentals and Flow of Funds.
2. E Mossialos,et al. : Regulating Pharmaceuticals in Europe.
3. S O Schweitzer : Strivingfor Efficiency, Equity and Quality
4. P M Danzon : Pharmaceutical Economics and Policy
5. W S Comanor : Pharmaceutical Price Regulation
6. A J Culyer& J P Newhouse, Scherer : The Pharmaceutical Industry
7. 'The Political Economy of the Pharmaceutical Industry', Journal of Economic Literature, XXIV (September): 1178-1217 (1986);

* Other Books will be indicated by respective teachers.

B. Pharm Year 4: Semester-2
Course Title: Pharmaceutics-III- Lab
Course Code: PHARM 4205
Credit: 1

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

B. Pharm Year 4: Seemester-2
Course Title: Pharmacology-III- Lab
Course Code: PHARM 4206
Credit: 1

1. Determination of plasma proteins by the Biuret Method (Method of Reinhold).
2. Determination of paracetamol in blood by colorometric method.
3. Estimation of cholesterol in human blood by enzymatic method.
4. Estimation of cholesterol in human blood by chemical method.
5. Estimation of indometacin in human blood by spectrophotometric method.
6. Toxicity test of the drugs like, phenobarbitone, nikethamide, some antineoplastic drugs, pilocarpine, etc
7. Estimation of glucose in blood in normal condition and after administration of insulin
8. Biological assay of digitalis, histamine and insulin
9. Microbiological assay of antibiotics and vitamins;
10.spectrophotometric estimation of blood pigments.

2

B. Pharm Year 4: Semester-2
Course Title: Cosmetology- Lab
Course Code: PHARM 4207
Credit: 1

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

B. Pharm Year 4: Seemester-2
Course Title: Pharmaceutical Internship
Course Code: PHARM 4208
Credits: 2

Every student must complete 4 weeks of internship in any Pharmaceutical company. After completion of internship every student must submit their report as well as attend in a presentation and Viva voce.

B. Pharm Year 4: Seemester-2
Course Title: Viva voce
Course Code: PHARM 4209
Credit: 1

Every student must give a Viva voce at the end of B. Pharm Year IV. Topics of the Viva voce will cover from any course of Semester-7 and Semester-8 and current affairs of Pharmaceuticals.

B. Pharm Year 5: Semester-1
Course Title: Quality Control and Analytical Method Validation
Course Code: PHARM 5101
Credits: 4

1. Quality Control Overview: Introduction, general information & significance of quantitative and qualitative analyses in quality control, sampling techniques. Pharmacopoeial tests and specifications, standardization of pharmaceuticals and formulated products, quality control systems for drugs and pharmaceuticals, causes of poor quality, Importance of pharmaceutical analysis in the quality control of drugs, sources of quality variation, control of quality variation.
2. Terminology and Validation Overview: Introduction, terminology used in the validation of analytical procedures, regulatory basis for process validation.
3. Validation of Analytical Methods: Strategy and parameters for the validation of methods, verification of standard methods, validation of non-routine methods, analytical validation within the pharmaceutical environment, validation of standard operating procedures (SOP). linearity, accuracy, precission, limit of detection, limit of quantification, heat sensitivity and system suitability.
4. Overview of Pharmaceutical Product Development and Its Associated Quality System: Discovery research, preclinical phase, clinical phases, regulatory submission, quality system for the analytical development laboratory.
5. Potency Method Validation: Validation practices, strategies and validation parameters, potency method revalidation, common problems and solutions.
6. Method Validation for HPLC Analysis: Introduction, background information, method validation experiments, common problems and solutions.
7. Performance Verification:

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

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

c) Performance Verification of NMR and MS spectrophotometers: Introduction, calibration of spectra, internal standards, common problems and solutions.

d) Karl fisher Apparatus and Its Performance Verification: Introduction, instrumentation, performance verification, common problems and solutions.

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

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

10. Pharmaceutical Process Validation: Importance, type of process validation, validation of dissolution process, mixing process, granulation process, tablet compression process, tablet coating process, capsule filling process, injection vial filling process.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Semester-1
Course Title: Nutraceuticals and Herbal Medicine
Course Code: PHARM 5102
Credits: 4

1. Introduction: Definition of functional foods, nutraceutical and herbal medicine, their role in disease and diseas management.

2. Functional Foods: Effect of processing of functional food on nutrients, effect of soy proteins and soy isoflavones in human health, role of dietary fibers in disease prevention, sources and role of isoprenoids, isoflavones, flavonoids, carotenoids, tocotrienols, polyunsaturated fatty acids, sphingolipids, lecithin, choline, terpenoids, vegetables, cereals, milk and dairy products as functional foods, health effects of common beans, capsicumannum, mustards, ginseng, garlic, grape, citrus fruits, fish oils, and sea foods.

3. Nutritional Requirements:

Balanced diet, factors affecting BMR and energy requirements for different activities, role of different nutrients in health and disease, nutritional requirements for different types of physical activities and sports, special needs before and after certain intensive and prolonged sports (Pre-game and Post-game meals), nutritional requirements of vulnerable sections such as infants, pregnant and lactating women, elderly and the dietary management, malnutrition: Occurrence, manifestation, prevention and therapeutic measures including fortification, formulation of diet and foods for specific needs.

4. Anti-nutritional Factors Present in Foods:
Types of inhibitors present in various foods and how they can be inactivated, general idea about role of probiotics and prebiotics as nutraceuticals, recent advances in techniques & feeding of substrates, assessment of nutritional status and recommended daily allowances.

5. 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.

6. Nutraceuticals in Herbal Products, Fruits, Vegetables and Grains with Health Benefits: Effects of nutraceutical on cancer, immune system; phytochemicals and their roles in prevention of specific diseases; antioxidant, antidiabetic, anti-inflammatory a hypolipedimic herbs and nutraceuticals.

7. 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.

8. Herbal Products for Personal Care.
Different ways of skin care and role of herbal products for skin care, skin disorders and herbal remedies, hair care and skin/scalp herbal remedies, herbal baths, aromatherapy.

Recommended Books:

1. Costas G. Biliaderis et al. : Functional Food Carbohydrates.
2. FereidoonShahidi : Nutraceutical and Specialty Lipids and their Co-Products.
3. Lisa Turner : A Nutraceutical Approach to Diet and Health.
4. W. Jeffrey Hurst : Methods of Analysis for Functional Foods and Nutraceuticals.
5. Robert E. C. Wildman : Handbook of Nutraceuticals and Functional Foods.
6. FereidoonShahidi et al : Nutraceutical Beverages: Chemistry, Nutrition, and Health Effects
7. Jean-Richard Neeser et al : Bioprocesses and Biotechnology for Functional Foods and Nutraceuticals.

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Semester-1
Course Title: Drug and Disease Management-II
Course Code: PHARM 5103
Credits: 4

1. Contraception: Advantage and disadvantages of combined oral contraception (COC); symptoms including the need to stop taking COC immediately; advice when stopping or changing the COC; advice given to a patient who forgets to take a progestogen only pill (POP) or the COC pill; other forms of contraception available to women where COC and POP are unsuitable or are not their first choice; the role of the pharmacist in the supply of emergency hormonal contraception.

2. Women's Health: Common symptoms associated with cystitis, thrush, dysmenorrhoea and pre-menstrual tension (PMT); suitable OTC treatments, advice pharmacists should give about these conditions; patients needing referral to other health care professionals.

3. Osteoporosis: Etiology and pathology of osteoporosis; risk factors for the development of osteoporosis; lifestyle advice for prevention and treatment of osteoporosis; hormone replacement

(HOURT) regimens; risks and benefits of HOURT; advantages and disadvantages of selective oestrogen receptor modulators (SERMS) and bisphosphonates.

4. Urinary Tract Infections: Clinical features of urinary tract infections and population groups at risk; natural history and current treatment options in relation to UTls; therapeutic options for resistant UTl.

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

6. Diabetes: Etiology and pathogenesis of type 1 and type 2 diabetes; aims of diabetes management; dietary and lifestyle advice for diabetes, the pharmacists' role in the prevention and identification of undiagnosed diabetes; core elements education programmes; prevention and management of hypoglycaemia; advice that should be given during intercurrent illness; the pharmacists role in risk modification to prevent long-term complications.

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

8. Oral Hygiene: The impact of fluoride in preventing gum disease, how a patient should choose and use a suitable toothbrush and the treatment of mouth ulcer, candidosis and angular cheilitis, wound care, the different stages in the healing process, the factors that can affect wound healing, the different wound types, the characteristics of an ideal dressing and the properties and actions of available dressings.

9. Childhood Conditions: The symptoms, treatment and advice for common childhood conditions and childhood immunisation schedule. pharmaceutical care in children-why drug handing varies for different age ranges, dosing conventions used to calculate drug doses in children, unlicensed and off-label drug used in children, medicines taking and concordance issues in children.

10.Management and treatment of different cardiovascular diseases.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Semester-1
Course Title: Clinical Research and Clinical Pharmacokinetics
Course Code: PHARM 5104
Credits: 3

1. Definition of Clinical Research: Guidelines for undertaking clinical trials, data to be submitted for clinical trial structure, content & format for clinical study report, approval for clinical trials, responsibility of sponsor, investigator & ethical committee.

2. Basic Concept and General Discussion on Clinical Research: Pre clinical, toxicity studies, evolution of drugs and regulatory framework, drugs discovery and development, clinical data management, ICH GCP introduction.

3. Pharmacokinetics of Drug Molecules in Different Disease Conditions: In-vivo in-vitro relationship study, detail pharmacokinetics for bioequivalence study of different formulations, drug-drug interaction study, pharmacokinetics of drug molecules in different populations.

4. Kinetics following Extravascular Administration: Describe concentration: time profile of first order absorption, define absorption rate constant and bioavailability, estimation of pharmacokinetic parameters following extravascular administration.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Semester-1
Course Title: Biostatistics
Course Code: PHARM 5105
Credits: 3

1. Introduction to statistics: Definition, scope and application of statistics in Pharmacy, collection and presentation of data, arithmetic mean, geometric mean, harmonic mean, weighted mean, median and mode, equation of straight lines; determination of slope and intercept, graphs and diagrams

2. Measures of dispersion: Range, mean deviation, standard deviation, variation, coefficient of variation, standard deviation; moments, skewness, and kurtosis.

3. Basic concept of probability and probability distribution: The normal, binominal and Poisson distribution, derivation, means and variances.

4. Tests of Hypothesis: Basic concepts of tests of significance, tests of means and variances based on normal, t, χ^2 and F distributions, tests of independence in a contingency table.

6. The correlation and regression analysis of measurement: General concept of correlation and regression, calculation of correlation coefficient; basic idea of regression, calculation of regression coefficient.

Recommended Books:

1. J. E. Freund and G. A. Simon : A Modern elementary statistics
2. J. S.Miltion& J. O. Tsokos : Statistical Methods in the Biological and Health Sciences
3. B. K. Mahajan : Methods in Biostatistics for Medical Students and Research Workers
4. Gupta, S.C. and Kapoor, V.K.(1.001) : Fundamentals of Applied Statistics
5. Yule, G. U. and Kendall, M. G. : An Introduction to the Theory of Statistics
6. Mosteller, F., Rourke and Thomas : Probability with Statistical Applications
7. Anderson, A.J.B : Interpreting Data
8. Cramer, H. : The Elements of Probability Theory

9. Ross, S.M. : Introduction to Probability Models

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Seemester-1
Course Title: Bioinformatics
Course Code: PHARM 5106
Credits: 2

1. Introduction: Definition of bioinformatics, basic concepts of protein and nucleic acid, sequence, structure and function.
2. Bioinformatics Databases: Introduction, nucleotide sequence databases, primary nucleotide sequence databases, secondary nucleotide sequence databases, protein sequence databases, sequence motif databases, protein structure databases.
3. Sequence Alignment and Database Searching: Single sequence alignments, biological motivation, pairwise alignments, database searching including BLAST, multiple sequence alignments.
4. Protein Structure Alignments: Definition of structure superposition, structure alignment, different alignment algorithms, number of protein folds in PDB.
5. Phylogenetics: Sequence-based taxonomy, from multiple alignment to phylogeny, computer tools for phylogenetic analysis.
6. Metabolism and Networks.

Recommended Books:
1. Larson : Bioinformatics & Drug Discovery
2. CHouristineOrengo : Bioinformatics: Genes, Proteins and Computers

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Semester-1
Course Title: Quality Control and Analytical Method Validation- Lab
Course Code: PHARM 5107
Credit: 1

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

B. Pharm Year 5: Semester-1
Course Title: Clinical Research and Clinical Pharmacokinetics-Lab

Course Code: PHARM 5108
Credit: 1

1. The practical course will be conducted as designed by the course teacher.
2. Determination of Liver marker: SGPT, SGOT, TP, etc.
3. Determination of Kidney marker: Creatine, creatinine etc.
4. Determination of Lung function: FVC, PEFR, FEV_1, FVC/FEV_1 etc.
5. Determination of Analgesic activity of drugs or extracts: Tail immersion test, Writhing test etc.
6. Determination of anti inflammatory effect of drugs or extracts: Carragenan induced paw edema test.
7. Determination of antidiarrhoeal activity of drugs or extracts: Castor oil induced diarrhea.

B. Pharm Year 5: Semester-2
Course Title: Toxicology and Drug Interactions
Course Code: PHARM 5201
Credits: 4

1. Basic Concept and General Discussion on Clinical Research: Pre clinical, toxicity studies, evolution of drugs and regulatory framework, drugs discovery and development, clinical data management, ICH GCP introduction.
2. **Acute Poisoning:** The different types of poisoning, the general principles of management of acute poisoning and the management of poisoning with aspirin, paracetamol and drugs of misuse.
3. Animal Toxicology: (non-clinical toxicity study), Animal pharmacology, human pharmacology (phase I), therapeutic exploratory trail (phase II), therapeutic confirmatory trails (phase III), post marketing trails (phase IV), studies in special population, special studies: bioavailability /bioequivalence, pharmacovigilance.
4. Clinical Toxicology: Role of poison centers, adverse reactions and poisoning incidences, analysis of poisoning situations, poison information sources, assessment of poison exposure.
5. Clinical Signs, Symptoms and Management of Poisoning: Case with pesticides, fumigants, solvents, vapors, gases, food toxins, cyanides poison, cosmetics, toxins of animal origin, over-doses of drugs, drug interactions etc.
6. Determination of: LD_{50}, LC_{50},acute toxicity,bioassays, neurotoxicity utilizing forced locomotor activity test, determination of convulsant dose for CNS stimulants, experiments on neuromuscular relaxation, animal experiments with abuse drugs.
7. Case History Study of Patients with: (a) Constipation and diarrhea, (b) Hypertension, (c) Pain, (d) Nausea and Vomiting (e) Diabetes mellitus (f) Drug in pregnancy and lactation, (g) Eczema and psoriasis.
8. Heavy Metal Poisoning:
9. Hypersensitivity Reaction:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Seemester-2
Course Title: Pharmacy Practice
Course Code: PHARM 5202
Credits: 4

1. Therapeutic Drug Monitoring of Aminoglycosides and Vancomycin in Hospitalized Patient: Assessment of peak and trough concentration of the antibiotics during treatment to avoid toxicities.
2. Empirical Uses of Antibiotics in Different Infections: Choice of antibiotics on the basis of culture sensitivity report, antibiotics in clean cut surgery, antibiotics uses in intra-operative surgery.

3. Antibiotic Policy in a Hospital: Role of physicians and pharmacist in implementing the antibiotic policy in a hospital setting.
4. Assessment of Medication to the Patients Undergoing Cardiac Surgery: Coronary artery stenting, closing of atrial septal defect (ASD) through surgery, closing of petentductusarteriosus in neonates through surgery and medicines used for treatment of petentductusarterious, patient management in coronary care unit (CCU), drug use management in cardiac patient
5. Drug Uses and Management During Pregnancy: Relatively safe drugs, drug associated with some risk, drugs contraindicated during pregnancy.
6. Total Parenteral Nutrition (TPN): Requirements of TPN in a hospital setting, types of patients need TPN, calculation and preparation of TPN by the pharmacist in a hospital following good professional practice, TPN required in pre-termed baby, TPN required by a cancer patient unable to take food orally, TPN to patient in long term unconsciousness etc.
7. Extemporaneous Preparation: Professional justification, legal justification, compounding accuracy and medication potency, sources of medicinal ingredients, examples of some oral preparations, dermatological preparations, ophthalmic preparations, parenteral admixtures.
8. Therapeutic Management of Patient in Intensive Care Unit (ICU) with Case Studies.
9. Dispensing of Anticancer Drug by the Pharmacist and Its Rationale: Pre- and post medication of the patient during chemotherapy, side effects and risk of anticancer drugs
10. Dosage Adjustment of Medicines in Patients with Hepatic and Renal Failure.
11. Adverse Drug Reaction Reporting and Role of Pharmacist in Prevention ADR Event.
12. Prescription Error: Types and assessment, role of pharmacist in prevention.

Recommended Books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Seemester-2
Course Title: Drug and Disease Management-III
Course Code: PHARM 5203
Credits: 4

1.Hepatic Disease and Their Management: Sign and symptoms, common causes, complications, diagnosis, and management of alcoholic liver disease, acute liver failure, drug and toxin induced hepatotoxicity, liver cirrhosis, management of patients with chronic liver diseases**,** treatment of viral hepatitis (B and C) etc.

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

3.Management of Different Cancer: Application of medications, food, radiation, physical activity for management of cancers such as prostate cancer, pancreatic cancer, breast cancer, blood cancer, colon cancer, lung cancer, thyroid cancer; occupational and environmental exposures in cancer; complimentary and alternate medicine approaches to cancer prevention of cancers; management of acute pain in cancer patients.

4. Management of HIV/AIDS: Management of AIDS patients by using different classes of drugs such as nucleoside reverse transcriptase inhibitors (NRTI) and nucleotide reverse transcriptase inhibitors (NtRTI), non-nucleoside reverse transcriptase inhibitors (NNRTI), integrase inhibitors, protease inhibitors, combination therapy, fixed-dose combinations, antiretroviral therapy. Management by other means such as patients education on ADIDS, current guidelines, prevention of mother-to-child-transmission (PMCT), additional diet tips, awareness of AIDS to the people.

5. Management of Gastrointestinal Diseases: gastroesophegousreflax disease (GRD), gastric acidity, diarrhoea, dysentery, constipation, ulcer etc.; Management of Inflammatory bowel diseases(IBD): diagnosis and management, immunomodulators and biologic therapy for IBD, advancements, post surgical management of IBD, complications of IBD/ surgical complications and management, serologic markers and drug metabolite in IBD, issues in surveillance and management of dysplasia in IBD; Approaches to food and drugs for proper control of gastrointestinal diseases.

6. Management of Eye Disease: Treatment and management of various eye diseases such as thyroid eyedisease, glaucoma, cataract,dry eye**s**yndrome,maculardegeneration,retinaldetachment,conjunctivitis,blepharitis,trachomaetc.

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

Recommended books:

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

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Seemester-2
Course Title: Pharmaceutical Regulatory Affairs and Ethics
Course Code: PHARM 5204
Credits: 3

1. Regulations and laws governing the practices of pharmacy in Bangladesh (The Pharmacy Ordinance 1976), role of Pharmacy Community of Bangladesh
2. Policies, sales, regulation and laws concerning to the manufacture, possession, distribution, sale of drugs and poisons:
a) The Drug Act 1940 (XXIII of 1940)
b) The Drug Ordinance 1982
c) The Drug Policy 1982
d) The Drug (Control) Ordinance 1982 (Ordinance No. VIII of 1982), its amendments
e) The Narcotics (control) Act 1990
f) The National drug policy 2005 for regulation of process of registration.
g)manufacturdistribution, sale, import, and export of drug in Bangladesh.
h)The Poisons Act 1919 and related amendments
3. Approval process, format and registration of pharmaceuticals in Bangladesh.
4. Rules and regulations for controlling poisons and narcotic materials in Bangladesh.
5. Control of drug advertisements and prices, patented and trademarked medicine, proprietary medicine, regulation of cosmetics and poison control.
6. Schedules of drugs and poisons.
7. The Pharmacist's code of ethics

Recommended Books:
1. Pharmacy Ordinance 1976 : Ministry of Law and Parliamentary Affairs, Govt. of Bangladesh
2. The Drugs (control) Ordinance : Ministry of Law and Land Reforms, Government of Bangladesh
3. Drug Policy of Bangladesh : Ministry of Health and Population Control, Govt. of Bangladesh
4. Textbook of Forensic Pharmacy : B.M. Mithal.
5. Pharmacist's Code of Ethics : Pharmacy Council of Bangladesh.

* Other Books will be indicated by respective teachers.

B. Pharm Year 5: Seemester-2
Course Title: Hospital and Community Pharmacy Internship
Course Code: PHARM 5205
Credits: 3

Students must go through rigorous hospital training for a period of at least 600 hours. Hospital authority will arrange their visit in each unit of the hospital; will give training about how to manage patients in different critical conditions, prevention of diseases, use of drugs etc. After completion of training, students will produce their work report as well as attend presentation through multimedia and viva voce in the department of pharmacy.

B. Pharm Year 5: Seemester-2
Course Title: Research Project
Course Code: PHARM 5206
Credits: 3

Project titles will be provided by the supervisor of the student. The supervisor will be in overall charge of the management of the project and will also ensure that the student adheres to the project regulations and requirements. At the end of the project each student will submit a dissertation and give an oral presentation of his or her findings.

B. Pharm Year 5: Seemester-2
Course Title: Viva voce
Course Code: PHARM 5207
Credits: 2

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