

# **BIJU PATNAIK UNIVERSITY OF TECHNOLOGY ODISHA, ROURKELA.**



## **SYLLABUS FOR FOUR-YEAR B.PHARMACY PROGRAMME (UNDER SEMESTER PATTERN)**

**(w.e.f. 2015-16)**



## **INSTITUTE OF PHARMACY & TECHNOLOGY, SALIPUR CUTTACK-754202, ODISHA**

**Vision:** *To generate competent Pharma human resources.*

**Mission:** *To impart quality education in Pharmacy with continuous enrichment of knowledge and skill, to inculcate the competitive attitude, leadership quality with ethical approach, to meet the dynamic needs of the global village in all relevant fields.*

**B.PHARM SYLLABUS STRUCTURE & CONTENTS FOR****2015-16 Admission Batch onwards****Internal Evaluation Scheme**

Attendance & Class Interaction	05
Assignment	05
Surprise Test	05
Quiz	05
Class Test (I & II)	30
Total	50
Class Test Time	01 Hour

Pass Mark in Internal is 50% of total marks i.e. **25**

**External Evaluation Scheme**

University Semester Examination of 3 Hours duration. Pass mark will be 35% which means students have to score 35 out of 100.

**Practical/Sessional Evaluation Scheme**

Pass mark will be 50% which means students have to score **25** out of 50.

**Evaluation Scheme**

Attendance & Daily Performance	-	10
Lab Record	-	10
Lab Quiz	-	05
Final Experiments & Viva	-	25
<b>Total</b>	-	<b>50</b>

# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, ODISHA, ROURKELA

## 1<sup>st</sup> SEMESTER

Theory							Practical		
Subject Group	Subject Code	Course Name	Hours /Week L/T	Credit Theory	University marks	Internal Evaluation	Hours /week L/T	Credit Practical	Marks
PC	15PH101	PHARMACEUTICS - I	3-0	3	100	50	3	2	50
PC	15PH102	INORGANIC PHARM CHEMISTRY	3-0	3	100	50	3	2	50
PC	15PH103	HAP - I	3-0	3	100	50	3	2	50
HM	15PH104	COMMUNICATIVE-ENGLISH	2-0	2	100	50	2	1	50
BS	15PH105	REMEDIAL BIOLOGY (Elective)	2-0	2	100	50	2	1	50
BS	15PH106	REMEDIAL MATHEMATICS (Elective)	3-1	3	100	50	-	-	-
<b>Total</b>			<b>13/14-1</b>	<b>13/14</b>	<b>500</b>	<b>250</b>	<b>13/11</b>	<b>8/7</b>	<b>200/250</b>
<b>Total Hours/Week</b>			<b>26</b>						
<b>Total Credits</b>			<b>21 (PC 15 HM 03 BS 03)</b>						
<b>Total Marks</b>			<b>900/950</b>						

## 2<sup>nd</sup> SEMESTER

Theory							Practical		
Subject Group	Subject Code	Course Name	Hours /Week L/T	Credit Theory	University marks	Internal Evaluation	Hours /week L/T	Credit Practical	Marks
PC	15PH201	PHARM ANALYSIS - I	3-0	3	100	50	3	2	50
PC	15PH202	HAP - II	3-0	3	100	50	3	2	50
PC	15PH203	PHARMACOGNOSY- I	3-0	3	100	50	3	2	50
PC	15PH204	ORGANIC CHEMISTRY - I	3-0	3	100	50	3	2	50
HM	15PH205	Business Communication in English	2-0	2	100	50	2	1	50
PC	15PH206	Hospital and Community Pharmacy	3-0	3	100	50	-	-	-
<b>Total</b>			<b>17</b>	<b>17</b>	<b>600</b>	<b>300</b>	<b>14</b>	<b>9</b>	<b>250</b>
<b>Total Hours/Week</b>			<b>31</b>						
<b>Total Credits</b>			<b>26 (PC 23 HM 03)</b>						
<b>Total Marks</b>			<b>1150</b>						

### 3<sup>rd</sup> SEMESTER

Theory							Practical		
Subject Group	Subject Code	Course Name	Hours /Week L/T	Credit Theory	University marks	Internal Evaluation	Hours /week L/T	Credit Practical	Marks
PC	15PH301	Physical Pharmaceutics-I	3-0	3	100	50	3	2	50
BE	15PH302	Pharm. Engineering-I	3-0	3	100	50	-	-	-
BS	15PH303	Organic Chemistry-II	3-1	3	100	50	3	2	50
PC	15PH304	Pharmacognosy-II	3-0	3	100	50	3	2	50
PC	15PH305	Pathophysiology of Common Diseases	3-0	3	100	50	-	-	-
BS	15PH306	Environmental Science	2-0	2	100	50	-	-	-
<b>Total</b>			<b>17-1</b>	<b>17</b>	<b>600</b>	<b>300</b>	<b>9</b>	<b>6</b>	<b>150</b>
<b>Total Hours/Week</b>			<b>27</b>						
<b>Total Credits</b>			<b>23 (PC 13 BE 03 BS 07)</b>						
<b>Total Marks</b>			<b>1050</b>						

Lateral Entry students with D.Pharm qualification are required to take course no. 15PH104 (Communicative English theory and practical) and Course No. 15PH105 (Remedial Biology Theory\*& Practical\*) OR 15PH106 (Remedial Mathematics\*) as the case may be in addition to the above courses of 3rd Semester.

\*Candidates who did not pass Biology subject in entry qualification (+2 Sc. etc.) examination are required to take Remedial Biology (T&P), and those who did not pass Mathematics subject are required to take Remedial Mathematics. Candidates who passed both Biology and Mathematics can take either Remedial Biology (T&P) or Remedial Mathematics

### 4<sup>th</sup> SEMESTER

Theory							Practical		
Subject Group	Subject Code	Course Name	Hours /Week L/T	Credit Theory	University marks	Internal Evaluation	Hours /week L/T	Credit Practical	Marks
PC	15PH401	PHYSICAL PHARMACY-II	3-0	3	100	50	3	2	50
PC	15PH402	PHARMA ENGINEERING-II	3-0	3	100	50	3	2	50
PC	15PH403	BIOCHEMISTRY	3-0	3	100	50	3	2	50
PC	15PH404	COMPUTER APPLICATION	3-0	3	100	50	3	2	50
HM	15PH405	ORGANIC CHEMISTRY-III	3-0	3	100	50	-	-	-
PC	15PH406	MATHEMATICS & STATISTICS	3-0	3	100	50	-	-	-
<b>Total</b>			<b>18</b>	<b>18</b>	<b>600</b>	<b>300</b>	<b>12</b>	<b>8</b>	<b>200</b>
<b>Total Hours/Week</b>			<b>30</b>						
<b>Total Credits</b>			<b>26 (PC 13 BE 05 BS 08)</b>						
<b>Total Marks</b>			<b>1100</b>						

Lateral Entry students with D.Pharm qualification are required to take course no. 15PH205 (Business Communication in English theory and practical) in addition to the above courses of 4th Semester.

<b>5<sup>th</sup> SEMESTER</b>									
<b>Theory</b>							<b>Practical</b>		
<b>Subject Group</b>	<b>Subject Code</b>	<b>Course Name</b>	<b>Hours /Week L/T</b>	<b>Credit Theory</b>	<b>University marks</b>	<b>Internal Evaluation</b>	<b>Hours /week L/T</b>	<b>Credit Practical</b>	<b>Marks</b>
PC	15PH501	Pharmaceutics-II (Pharmaceutical Technology - I)	3-0	3	100	50	3	2	50
PC	15PH502	Medicinal Chemistry-I	3-0	3	100	50	3	2	50
PC	15PH503	Pharm. Analysis-II	3-0	3	100	50	3	2	50
PC	15PH504	Pharmacology-I	3-0	3	100	50	3	2	50
PC	15PH505	Pharmacognosy-III	3-0	3	100	50			
PC	15PH506	Pharmaceutical Microbiology	3-0	3	100	50	3	2	50
<b>Total</b>			<b>18</b>	<b>18</b>	<b>600</b>	<b>300</b>	<b>15</b>	<b>10</b>	<b>250</b>
<b>Total Hours/Week</b>			<b>33</b>						
<b>Total Credits</b>			<b>28 (PC 28)</b>						
<b>Total Marks</b>			<b>1150</b>						

<b>6<sup>th</sup> SEMESTER</b>									
<b>Theory</b>							<b>Practical</b>		
<b>Subject Group</b>	<b>Subject Code</b>	<b>Course Name</b>	<b>Hours /Week L/T</b>	<b>Credit Theory</b>	<b>University marks</b>	<b>Internal Evaluation</b>	<b>Hours /week L/T</b>	<b>Credit Practical</b>	<b>Marks</b>
PC	15PH601	Pharmaceutics-III (Pharm. Tech-II)	3-0	3	100	50	3	2	50
PC	15PH602	Medicinal Chemistry-II	3-0	3	100	50	3	2	50
PC	15PH603	Pharmacology-II	3-0	3	100	50	3	2	50
PC	15PH604	Pharmacognosy-IV	3-0	3	100	50	3	2	50
PC	15PH605	Pharm. Biotech	3-0	3	100	50			
PC	15PH606	Pharmaceutical Jurisprudence	2-0	2	100	50			
<b>Total</b>			<b>17</b>	<b>17</b>	<b>600</b>	<b>300</b>	<b>12</b>	<b>08</b>	<b>200</b>
<b>Total Hours/Week</b>			<b>29</b>						
<b>Total Credits</b>			<b>25 (PC 25)</b>						
<b>Total Marks</b>			<b>1100</b>						

**Hospital / Industrial Training for six weeks during summer vacation - 4 credits**

<u><b>7<sup>th</sup> SEMESTER</b></u>									
<b>Theory</b>							<b>Practical</b>		
<b>Subject Group</b>	<b>Subject Code</b>	<b>Course Name</b>	<b>Hours /Week L/T</b>	<b>Credit Theory</b>	<b>University marks</b>	<b>Internal Evaluation</b>	<b>Hours /week L/T</b>	<b>Credit Practical</b>	<b>Marks</b>
PC	15PH701	Biopharmaceutics and Pharmacokinetics	3-0	3	100	50	3	2	50
PC	15PH702	Phytochemistry	3-0	3	100	50	3	2	50
PC	15PH703	Pharm. Analysis-III	3-0	3	100	50	3	2	50
PC	15PH704	Pharmacology-III	3-0	3	100	50			
PW	15PH705	Research Methodology	3-0	2	100	50			
PE	15PH706	Professional Elective-I	3-0	2	100	50			
PW	15PH707	Minor Project (Literature Review/ Soft Skill Development/ In-house Training)					5	4	100
<b>Total</b>			<b>18</b>	<b>16</b>	<b>600</b>	<b>300</b>	<b>14</b>	<b>10</b>	<b>250</b>
Total Credits 26 (PC 18 PE 02 PW 06)                      Total Marks 1150									
<b><u>Professional Elective-I</u></b>									
<b>1. Drug Regulatory Affairs &amp; IPR (15PH706.E.1)</b> <b>2. Cosmetic Technology (15PH706.E.2)</b>									

**1<sup>st</sup> Semester**

**PHARMACEUTICS-I**

**15PH101      THEORY**

**3 hours / week**

**Module - I**

**Evolution of Pharmacy and Pharmaceutical Literature:** History of Pharmacy in India. Drugs Enquiry Committee, 1930, Brief history and contribution of Prof. M.L. Scroff, Historical background and importance of various Pharmacopoeias with special reference to Indian Pharmacopoeia, International Pharmacopoeia and Extra Pharmacopoeia, Drug Formularies etc.

Orientation and Scope of Pharmacy : Pharmacy profession, legislations, ethics, oath, professionalism, careers, practice of community pharmacy, pharmacist in industry, pharmacist in government, pharmacist & public health, clinical pharmacy, information resources in pharmacy & pharmaceutical sciences.

**Module – II**

**Introduction and classification of pharmaceutical dosage forms:**

Principles and methods of preparation of aromatic waters, spirits, elixirs, glycerin, linctus, solutions, milks and magmas, mucilages and special preparations like pyroxylin and flexible collodions.

**Module – III**

**Prescription:** Various parts of prescription and their functions, handling of prescriptions, sources of errors, care required in dispensing procedures including labeling of dispensed products. Preliminary knowledge of important Latin terms used in prescriptions and their translation into English.

**Pharmaceutical calculations and metrology :** Metric and imperial systems of weights and measures used in prescriptions, posology, calculations of doses of infants, children, and elderly patients; reducing and enlarging formulae; percentage solutions; allegations methods; proof spirits; calculations involving alcohol dilutions.

**Module – IV**

**Principles and procedures of dispensing prescriptions :** Principles involved and procedures adopted in dispensing of liquid preparations such as mixtures, suspensions, emulsions, solutions, lotions, and liniments; semisolid preparations such as ointments, creams, pastes, jellies and suppositories; solid dosage forms such as powders, capsules, effervescent powders, tablet triturates and lozenges; paints, sprays, inhalations and poultices.

**Module - V**

**Incompatibilities:** Definitions, Types of incompatibility – Physical, Chemical and Therapeutic; Study of examples of prescriptions containing incompatibilities, their correction and dispensing methods.

**Galenicals:** Principles and methods of extraction, preparation of infusions, decoctions, tinctures, liquid, soft and dry extracts.

**PHARMACEUTICS-I**

**15PH101 PRACTICAL**

**3 hours/Week**

**(A minimum of 15 experiments shall be conducted)**

1. Preparation of selected pharmacopoeial preparations under the category of aromatic waters, spirits, infusions tinctures and extracts, (at least 10 preparations)
2. Dispensing procedures involving pharmaceutical calculations, dosage calculations for pediatric patients, etc.
3. Dispensing of prescriptions falling under the categories of mixtures, solutions, emulsions, creams, ointments, powders, suppositories, pastes, jellies, lotions liniments, inhalations and paints etc. (at least 30 preparations)
4. Dispensing of prescriptions involving adjustment of tonicity
5. Identification of various types of incompatibilities in prescriptions, correction and dispensing of such prescriptions (at least 10 prescriptions).

**RECOMMENDED BOOKS:**

1. Cooper & Gunn's Dispensing for Pharmaceutical students CBS Publishers, New Delhi
2. Dispensing Pharmacy by R.M. Mehta (Vallabh Prakashan, Delhi)
3. History of Pharmacy in India and related aspects volumes by Harikishan Singh
4. Text Book of Forensic Pharmacy by C.K. Kokate & S.B. Gokhale
5. A Text Book of Professional Pharmacy by N.K. Jain & S.N. Sharma
6. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems by Loyd V. Allen. Jr., Nicholas G. Popovich & Howard C. Ansel

**PHARMACEUTICAL CHEMISTRY-I (Inorganic Pharmaceutical Chemistry)**

**15PH102 THEORY**

**3 hours / week**

**Module - I**

Study of sources of impurities, tests for purity and identity, including limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate and special tests if any, of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia including acids, bases, buffers and water.

**Module - II**

An outline of methods of preparation and uses of the following compound:

Gastrointestinal Agents: Acidifying agents (Dil HCl), Antacids (Aluminum hydroxide gel, Aluminum phosphate, Magnesium carbonate, Magnesium trisilicate, combination preparation), Protectives and Adsorbents, Cathartics (Magnesium sulphate), Emetics (Copper Sulphate and Sodium potassium antimony tartrate).



**Module - III**

Essential and Trace Elements: Transition elements and their compounds of pharmaceutical importance, iron and haematinics, mineral supplements. Cationic and anionic components of inorganic drugs useful for systemic effects.

Topical Agents : Protectives (Calamine, Zinc oxide, Talc, Titanium dioxide), Astringents (Alum, Zinc sulphate) and Anti-infective (Iodine, Povidone iodine Hydrogen peroxide, Chlorinated lime, Potassium permanganate, Silver nitrate, Boric acid).

**Module - IV**

Gases and Vapours: Oxygen, Anaesthetics and Respiratory stimulants.

Dental Products: Dentifrices, Anti-caries agents

Major Intra and Extra-cellular Electrolytes : Physiological ions, Electrolytes used for replacement therapy, acid-base balance and combination therapy.

**Module - V**

Miscellaneous Agents: Sclerosing agents, expectorants, poisons and antidotes, sedatives etc. Pharmaceutical Acids – Anti-Oxidants, preservatives, filter aids, adsorbents, diluents, suspending agents, colorants etc.

Inorganic radio-pharmaceuticals: Nuclear radiopharmaceuticals, nomenclature, methods of obtaining their standards and units of activity, measurement of activity, clinical applications and dosage, hazards and precautions.

**PHARMACEUTICAL CHEMISTRY-I (Inorganic Pharmaceutical Chemistry)****15PH102****PRACTICAL****3 hours/Week****(A minimum of 15 experiments shall be conducted)**

1. Limit test for chlorides and sulphates in some pharmacopoeial compounds including soluble, insoluble and coloured substances ( 6 compounds or 3 experiments)
2. Limit test for iron and lead
3. Limit test for arsenic
4. Identification of radicals in mixtures
5. Acid radicals – at least two mixtures
6. Basic radicals – at least two mixtures
7. Preparation and identification tests of the following official (IP) compounds  
(i) Magnesium sulphate    (ii) Ferrous Sulphate    (iii) Alum  
(iv) Aluminium hydroxide    (v) Di-sodium hydrogen citrate
8. Preparation and testing of purified water

**RECOMMENDED BOOKS :**

1. Inorganic Medicinal and Pharmaceutical Chemistry by Block, Roche, Sonine, Wilson
2. Bentley and Driver's Text Book of Pharmaceutical Chemistry
3. Pharmaceutical Chemistry- Inorganic by G.R. Chatwal

**HUMAN ANATOMY AND PHYSIOLOGY-I (HAP-I)**

**15PH103      THEORY**

**3 hours / week**

**Module - I**

Scope of anatomy and physiology and basic terminology used in these subjects.

Structure of cell, its components and their functions.

Elementary tissues of the human body : Epithelial, Connective, Muscular and Nervous tissues, their sub types and characteristics.

**Module - II**

**Osseous System:** Structure, composition and functions of skeleton, classification of joints, types of movements of joints, disorders of joints.

**Module - III**

**Skeletal Muscles:** Gross anatomy and physiology of muscle contraction, physiological properties of skeletal muscles and their disorders.

**Module - IV**

**Haemopoietic System :** Composition and functions of blood and its elements, their disorders, blood groups and their significance, mechanism of coagulation, disorders of platelets and coagulation.

**Lymph and Lymphatic System:** Composition, formation and circulation of lymph; disorders of lymph and lymphatic system. Basic physiology and functions of spleen.

**Module - V**

**Cardiovascular System:** Basic anatomy of the heart, physiology, blood vessels and circulation. Basic understanding of cardiac cycle, heart sounds and electrocardiogram. Brief outline of cardiovascular disorders like hypertension, hypotension, arteriosclerosis, angina, myocardial infarction, congestive cardiac failure and cardiac arrhythmias.

**HUMAN ANATOMY AND PHYSIOLOGY-I (HAP-I)**

**15PH103      PRACTICAL**

**3 hours / week**

**(A minimum of 15 experiments shall be conducted)**

- |  |  |
|--|--|
| 1. Study of human skeleton   | 9. Estimation of haemoglobin in blood                            |
| 2. Study of the following systems with the help of charts and models | 10. Determination of bleeding time and clotting time             |
| 3. Haemopoietic System   | 11. RBC count  |
| 4. Lymphatic System  | 12. Total and differential leucocyte counts                      |
| 5. Cardiovascular System   | 13. Determination of ESR   |
| 6. Osseous System  | 14. Blood group determination                                    |
| 7. Skeletal Muscles  | 15. Recording of body temperature, pulse rate and blood pressure |
| 8. Microscopic study of different tissues                            |  |

**RECOMMENDED BOOKS:**

1. Anatomy & Physiology in Health and Illness by Ross and Willson (Churchill living stone)
2. Concise Medical Physiology by S.K. Choudhury (New central book agency, Calcutta)
3. Guyton A.C, Hall J.E., Text book of Medical Physiology, W.B. Sandnders Company
4. Human Physiology, CC Chatterjee, Medical allied agency, Calcutta
5. Tortora G.J., S.R. Grabowski & Anagnodokos N.P., Principles of Anatomy & Physiology
6. Dorasari and Gandhi's elements of Human anatomy, Physiology and health education by Thakorebhai P. Gandhi & R.K. Goyal (B.S. Shah Prakashan)

**COMMUNICATIVE ENGLISH**

**15PH104      THEORY**

**2 hours / week**

**Module-I:** The elements of communication

- 1.1 The importance of communication through English at the present time
- 1.2 The process of communication and factors that influence communication : sender, receiver, channel, code, topic, message, context, feedback, 'noise', filters and barriers
- 1.3 The importance of audience and purpose
- 1.4 The information gap principle : given and new information ; information overload
- 1.5 Verbal and non-verbal communication : body language
- 1.6 Comparing general communication and business communication

**Module-II:**

- 2.1 vowels, diphthongs, consonants, consonant clusters
- 2.2 the International Phonetic Alphabet (IPA) ; phonemic transcription
- 2.3 problem sounds
- 2.4 syllable division and word stress
- 2.5 sentence rhythm and weak forms

**Module-III:**

- 3.1 contrastive stress in sentences to highlight different words
- 3.2 intonation : falling, rising and falling-rising tunes
- 3.3 varieties of Spoken English : Standard Indian, American and British

Note: Module – II and Module - III should be taught in a simple, non-technical manner, avoiding technical terms as far as possible. )

**Module- IV:**

- 4.1 stative and dynamic verbs
- 4.2 the auxiliary system ; finite and non-finite verbs
- 4.3 time, tense and aspect
- 4.4 voice: active and passive
- 4.5 modality

**Module- V:**

- 5.1 negation
- 5.2 Interrogation ; reported and tag questions
- 5.3 conditionals
- 5.4 concord
- 5.5 Phrasal verbs

(Note The teaching of grammar should be treated as a diagnostic and remedial activity and integrated with communication practice. The areas of grammar in which errors are common should receive special attention when selecting items for review. Teaching need not be confined to the topics listed above.)

**Books recommended:**

1. An Introduction to Professional English and Soft Skills by B.K.Das et al., Cambridge University Press. (Facilitated by BPUT).

**COMMUNICATIVE ENGLISH**

**15PH104 PRACTICAL**

**2 Hours/Week**

Lab sessions will be devoted to practice activities based on all three modules of theory.

a. phonemic transcription

Students will be trained to find out the correct pronunciation of words with the help of a dictionary, to enable them to monitor and correct their own pronunciation.

i transcription of words and short sentences in normal English orthography (writing) into their IPA equivalents ;

ii transcription of words presented orally ;

iii conversion of words presented through IPA symbols into normal orthography

iv syllable division and stress marking (in words presented in IPA form)

b. Listening

i listening with a focus on pronunciation(ear-training) : segmental sounds, stress, weak forms, intonation Students should be exposed, if possible, to the following varieties of English during listening practice :

Standard Indian, British and American.

c. Speaking

i pronunciation practice (for accent neutralization), particularly of problem sounds, in isolated words as well as sentences

ii practising word stress, rhythm in sentences, weak forms, intonation

iii reading aloud of dialogues, poems, excerpts from plays, speeches etc. for practice in pronunciation

d. Grammar and usage

The focus will be on the elimination of common errors. Some writing activities (e.g. writing of short paragraphs on assigned topics) can be used to identify these errors.

### Project Work

Students will be required to produce and submit by the end of Semester I

A 350-500 word project report on a topic of their choice. The project should involve data collection, analysis and reporting. Ten marks (out of the 100 marks allocated for the Lab test ) will be set apart for the project.

### REMEDIAL BIOLOGY

#### **15PH105      THEORY**

**2 hours / week**

##### **Module - I**

Morphology: Root and stem modifications, leaf, flower, fruit & seed.

Anatomy: Tissue system in root, stem, leaf, bark & wood.

Plant cell: Organelles, cell division, tissues and types.

##### **Module - II**

Methods of classification: Artificial, natural and phylogenetic.

Plant taxonomy: Families; Apocyanaceae, Solanaceae, Fabaceae, Rubiaceae, Lamiaceae, Umbrelliferae, Papaveraceae, and Liliaceae

##### **Module - III**

Principal compounds of cell: Properties of Biological significance of the following:

Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acid, Vitamins, Plant hormones & growth inhibitors and Steroids

##### **Module - IV**

Animal Kingdom: Structure and life history of Amoeba, Entamoeba, Trypanosoma, Plasmodium, Taenia, Ascaris and Fasciola.

##### **Module - V**

General structure and life history of insects like Mosquito, Housefly, Mites and Silk worm.

### REMEDIAL BIOLOGY

#### **15PH105      PRACTICAL**

**2 hours / week**

**(A minimum of 15 experiments shall be conducted)**

1. Care, use and types of microscope
2. Morphology of plant parts indicate in theory, Preparation and microscopic examination of the following :
3. Stem of monocot and dicot plant
4. Root of monocot and dicot plant
5. Leaf of monocot and dicot plant

6 – 10 Gross identification of slides and structure and life cycle of lower plants and animals mentioned in theory

11-14 Structure of parasites and insects infecting human as mentioned in the theory

**RECOMMENDED BOOKS:**

1. A Text book of Zoology by Pati, Nanda & Ghosh (Kitab Mahal, Cuttack)
2. A Text book of Botany by A.K. Nanda
3. Pharmaceutical Botany by Heber W. Youngken (International Book Destination, Dehradun)
4. An Introduction of plant Anatomy by A.J. Eames and L.H. Dantels

**REMEDIAL MATHEMATICS**

**15PH106      THEORY**

**3 hours / week**

**Module - I**

**Algebra:** Equations reducible to quadratic, simultaneous equation (linear and quadratic). Determinants, properties of solution of simultaneous equations by Cramer's rule, matrices, definition of special kinds of matrices, arithmetic operations on matrices, inverse of matrix, solution of simultaneous equations by matrices, pharmaceutical applications of determinants and matrices. Evaluation of En1, En2 and En3 mensuration and its pharmaceutical applications.

**Module - II**

**Measures of Central Value:** Objectives pre-requisites of an ideal, measure mean, mode and median

**Trigonometry:** Measurement of angle, T-ratios, addition, subtraction and transformation formulae, T-ratios of multiple, sub-multiple, allied and certain angles, Application of logarithms in pharmaceutical computations.

**Module - III**

**Analytical Plans Geometry :** Certain co-ordinates, distance between two points, area of triangle, a locus of point, straight line, slope and intercept form double-intercept form, normal (Perpendicular form), slope-point and two point form, general equation of first degree.

**Module - IV**

**Calculus:**

(i) **Differential:** Limits and functions, definition of differential coefficient, differentiation of standard functions, including function of a function (chain rule). Differentiation of implicit functions, logarithmic differentiation, parametric differentiation, successive differentiation.

**Module - V**

**Integral:** Integration as inverse of differentiation, indefinite integrals of standard forms, integration by parts, substitution and partial fractions, formal evaluation of definite integrals.

**RECOMMENDED BOOKS :**

1. A Text Book of Mathematics for XI, XII students, NCERT Publications, Vol-I to IV
2. Elements of Mathematics (Vol.-I & II), Orissa State Bureau of Text Book Preparation and Production, Bhubaneswar
3. Topics in Mathematics by G. Das, R.S. Rath, B.P. Acharya, P. Mohapatra, S. Padhy (Part-I & II) (Kalyani Publisher, New Delhi)
4. Intermediate Mathematics (Vol.-I & II) by V. Venkateswara Rao, N. Krishnamurthy, B.V.S.S. Sarma. (S. Chand, New Delhi)
5. Higher Engineering Mathematics by Dr. J.S. Grewal (Khanna Publishers, New Delhi)

**2<sup>nd</sup> SEMESTER**

**PHARMACEUTICAL ANALYSIS –I**

**15PH201      THEORY**

**3 hours/week**

**UNIT –I**

**1. Introduction to Pharmaceutical Analysis:** Significance of qualitative analysis in quality control, Different techniques of analysis, Preliminaries and definitions, Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards, introduction to some basic techniques used in pharmaceutical analysis. Significance of figures. Rules for retaining significant digits. Types of errors, minimization of error, selection of sample for different pharmaceutical dosage forms, precision and accuracy.

**UNIT –II**

**1. Acid Base Titration:** Acid base concepts role of solvers, Relative strength of acids and bases, Ionization, Law of mass action, Common ion effect, ionic product of water, pH, Hydrolysis of salts, Henderson-Hasselbalch equation, Buffers solutions, Neutralization curves, Acid-base indicators, Theory of indicators, Choice of indicators, Mixed indicators, Polyamine and amino acid systems. Amino acid titration, applications in assay,  $H_3PO_4$ ,  $NaOH$ ,  $CaCO_3$  etc.

**UNIT –III**

**1. Non-aqueous Titrations:** Acidimetry & Alkalimetry. Basic principles, solvents involved indicators. Typical examples of Acidic & Basic drug molecules.

**2. Complexometric Titrations:** Types of complexometric titrations, Metal ion indicators, Complexometric titrations involving EDTA. Typical examples of complexometric titration.

**UNIT -IV**

**1. Precipitation Titrations:** Precipitation reactions, solubility product, effect of acids, temperature and solvent upon the solubility of a precipitate, Argentometric titration and titrations involving ammonium or potassium thiocyanate, mercuric nitrate and barium sulphate, Indicators, Gay-Lussac method; Mohr's method, Volhard's method and Fajan's method.

**UNIT-V**

**1. Oxidation Reduction Titrations :** Concepts of oxidation and reduction, Redox reactions, strengths and equivalent weights of oxidizing and reducing agents, Theory of redox titrations, Redox indicators, cell representations, Iodimetry and Iodometry, Titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate, Titanous chloride and sodium 2, 6-dichlorophenol indophenol.

**RECOMMENDED BOOKS:**

1. Vogel's Text book of Quantitative Chemical Analysis (Person Education, Singapore)
2. Garratt , The Quantitative analysis of drugs
3. H.H.Willard, Instrumental Methods of Analysis (CBS Publishers, Delhi)
4. Indian Pharmacopoeia Vol-1, 2 & 3



**PHARMACEUTICAL ANALYSIS –I**

**15PH201 PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Preparation and standardization of sodium carbonate, potassium hydrogen phthalate, sodium bicarbonate, oxalic acid.
3. Assay of boric acid, zinc oxide, ammonium carbonate and amino acids.
4. Preparation and standardization of silver nitrate and ammonium thiocyanate.
5. Titration according to Mohr's and Volhard's methods.
6. Preparation and standardization of perchloric acid and sodium methoxide and assay of one official drug under each type.
7. Preparation and standardization of EDTA solution and assay of calcium gluconate.
8. Preparation and standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Exercises involving potassium iodate, potassium bromate, iodine solution, sodium 2, 6-dichlorophenolindophenol, and ceric ammonium sulphate.

**HUMAN ANATOMY AND PHYSIOLOGY-II**

**(HAP-II)**

**15PH202 THEORY**

**3 hours/Week**

**UNIT -I**

**1. Digestive System:** Gross anatomy of the gastro-intestinal tract, functions of its different parts including those of liver, pancreas and gall bladder, various gastrointestinal secretions and their role in the absorption and digestion of food. Disorders of digestive system.

**UNIT - II**

**2. Respiratory system:** Anatomy of respiratory organs & its functions, respiration mechanism & regulation of respiration, respiratory volumes & vital capacity.

**UNIT -III**

**3. Central Nervous System:** Functions of different parts of brain & spinal cord. Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain, cranial nerves & their functions.

**4. Autonomic Nervous System:** Physiology & functions of the autonomic nervous system. Mechanism of neurohumoral transmission in the A.N.S.

**UNIT -IV**

**5. Urinary System:** Various parts, structures and functions of the kidney and urinary tract. Physiology of urine formation and acid-base balance. Diseases of the urinary system.

**6. Reproductive System:** Male and female reproductive systems and their hormones, physiology of menstruation, coitus and fertilization. Sex differentiation, oogenesis, spermatogenesis & organogenesis. Pregnancy, its maintenance and parturition.

**UNIT -V**

**7. Endocrine System:** Basic anatomy and physiology of Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas Testes and Ovary, their hormones and functions. Diseases in hypo and hyper secretions.

**8. Sense Organs:** Basic anatomy and physiology of the eye (vision), ear (hearing and balance), taste buds, nose (smell) and skin (superficial receptors).

**RECOMMENDED BOOKS:**

1. Anatomy and Physiology in Health and Illness by Ross and Willson (Churchill living stone)
2. Concise Medical Physiology by S.K.Choudhury
3. Guyton A C, Hall JE., Text book of Medical Physiology, W.B.Sandnders Company
4. Human Physiology, C C Chatterjee, Medical allied agency, Calcutta
5. Tortora G.J., & Anagnodokos N.P., Principles of Anatomy & Physiology

**HUMAN ANATOMY AND PHYSIOLOGY-II**

**(HAP-II)**

**15PH202      PRACTICAL**

**3 hours/Week**

**(A minimum of 15 practical shall be conducted)**

Study of the following systems with the help of charts and models:

1. Digestive system
2. Respiratory system
3. Central nervous system
4. Autonomic nervous system
5. Urinary system
6. Reproductive system
7. Endocrine system
8. Sense organs
9. Determination of vital capacity
10. Physiological experiments on nerve-muscle preparation
11. Microscopic study of different tissues
12. Study and preparation of permanent slides

**PHARMACOGNOSY – I**

**15PH203      Theory**

**3Hours/Week**

**UNIT – I**

1. Definition, history, scope and development of pharmacognosy.
2. Sources of drugs: Biological, marine, mineral and plant tissue culture as sources of drugs.
3. Classification of natural drugs: Alphabetical, Morphological, Taxonomical, Chemical, Pharmacological / Therapeutical and Chemotaxonomical classification of drugs.

**UNIT – II**

4. Cultivation, collection, processing and storage of plant drugs: Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.

**UNIT – III**

5. Quality control of crude drugs: (General methods only) Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation.
6. General introduction to secondary metabolites of plant origin with their properties.

**UNIT – IV**

7. Systematic pharmacognostic study of the following:
  - a) Carbohydrates and derived products: Agar, Guar gum, Acacia, Honey, Isabgol, Pectin Starch and Tragacanth.
  - b) Lipids: Bees wax, Castor oil, Cocoa butter, Cod-liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Shark liver oil and Wool fat.

**UNIT –V**

8. **Resins:** Study of Drugs Containing Resins and Resin Combination like colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafetida, balsam of tolu, balsam of Peru, benzoin, turmeric, ginger.
9. **Tannins:** Study of tannins and tannin containing drugs like gambir, black catechu, gall and myrobalan.

**PHARMACOGNOSY – I**

**15PH203      PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Identification of crude drugs belonging to carbohydrates (morphological and chemical).
2. Identification of crude drugs belonging to lipids.
3. Identification of crude drugs mentioned in theory (at least 5)
4. Study of fibres
5. Study of pharmaceutical aids.
6. Microscopic studies of 8-10 selected crude drugs and their powders mentioned in theory and their chemical tests.

**RECOMMENDED BOOKS:**

1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Balliere Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers & Distributors, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)

**PHARMACEUTICAL CHEMISTRY –II**

**(Organic chemistry-I)**

**15PH204      THEORY**

**3 hours/week**

**UNIT-I**

Bohr's atomic structure, Atomic and Molecular orbital concepts, Quantum numbers, Chemical bonding: Ionic bond, Covalent bonds, Coordinate covalent bonds, Type of covalent bonds, Tetravalency of carbon, Hybridization:  $sp^3, sp^2, sp$ . Bond energy, Bond length, Bond angle, Electronegativity, Polarity in Covalent bonds, Hydrogen bonding.

I.U.P.A.C. Nomenclature of Organic compounds.

**UNIT-II**

**Organic Reactions and their Mechanisms:**

Reaction mechanism, Electron Displacement Effects: Inductive Effect, Mesomeric Effect, Electromeric Effect, Hyperconjugative Effect. Homolytic bond fission, Heterolytic bond fission. Structure and Stability of: Carbonium ions, Carbanion ions and Free radicals. Attacking Reagents: Electrophilic reagents, Nucleophilic reagents.

Brief Concept of Organic reactions: Substitution reactions, Addition reactions, Elimination reaction and Rearrangement reactions.

**UNIT-III**

**Alkanes:** Nomenclature, General methods of preparation, physical properties, combustion, Free radical substitution reactions (Chain reaction: halogenation.)

**Cycloalkanes:** Nomenclature, General methods of preparation, Chemical reactions, Relative stabilities: Bayer strain theory, Sachse-Mohr concept of strainless rings. Conformational analysis of cyclohexane.

**Alkenes:** Nomenclature, general methods of preparation, Electrophilic addition reactions, Markovnikov rule, Antimarkovnikov rule, Catalytic hydrogenation, Oxidation, Combustion.

Brief introduction to alkadienes, Diel's Alder reaction.

**Alkynes:** Nomenclature, general methods of preparation, Electronegativity of  $sp$ -hybridized carbon and acidity of acetylene, Substitution and Addition reactions.

**UNIT-IV**

**Haloalkanes:** Nomenclature general methods of preparation, Nucleophilic Substitution reactions:  $SN_1$  &  $SN_2$  reactions.

**Alcohols:** Nomenclature, General methods of preparation, Physical properties (Hydrogen bonding) Nucleophilic substitution reactions and Elimination reaction, Saytzeff rule.

**Ethers:** Nomenclature, General methods of preparation, Physical and Chemical properties.

**Amines:** Nomenclature, General methods of preparation, Physical and Chemical properties, Basicity.

**UNIT –V**

**Aldehydes and Ketones:** General methods of preparation, acidity of  $\alpha$ -hydrogen Nucleophilic addition reactions, Aldol condensation reaction, Cannizzaro reaction, Clemmensen reduction.  $\alpha,\beta$ -unsaturated carbonyl compounds.

**Carboxylic acids:** Acid halides and anhydrides: Nomenclature, general methods of preparation, physical and chemical properties, Effect of substituent on acidity.

**Esters:** Nomenclature, preparations with special emphasis on synthesis of Malonic and acetoacetic esters and their synthetic applications.

**PHARMACEUTICAL CHEMISTRY –II**

**(Organic chemistry-I)**

**15PH204 PRACTICAL**

**3 hours/week**

(A minimum of 15 experiments shall be conducted)

1. Determination of Melting Point and Boiling Point
2. Identification of mono-functional organic compounds by a study of their physical properties, detection of characteristic functional group reactions and preparations of the rational derivative. The following type of compounds are included for the study: Carboxylic acids, phenol, aldehydes, ketones, amides, esters. hydrocarbons and carbohydrates.
3. Esterification of alcohol.

**RECOMMENDED BOOKS;**

1. Organic chemistry by Morrison and Boyd.(Prentice Hall of India, New Delhi)
2. Advanced organic chemistry by Bhal & Bhal (S.Chand, New Delhi)
3. Organic Chemistry Vol. 1 and II by I.L.Finar (Longman, Singapur)
4. Bently and Drivers text of Pharmaceutical chemistry by Oxford University, New Delhi

**BUSINESS COMMUNICATION IN ENGLISH**

**15PH205      THEORY**

**2 hours/week**

**UNIT-I**

**Introduction to Business Communication (4 hours)**

- 1.1 Patterns of communication in the business world: upward, downward, horizontal, grapevine etc
- 1.2 Internal and external channels of communication; formal and informal channels.

**UNIT-II**

**The Elements of Business Communication (6hours)**

- 2.1 Introduction to cross-cultural communication.
- 2.2 avoiding gender, racial and other forms of bias in communication
- 2.3 Common forms of oral and written communication in the business world: Oral presentations, interviews and group discussions Memos, reports, summaries and abstracts, e-mails

**UNIT-III**

**Reading (8 hours)**

- 3.1 the importance of developing reading skills
- 3.2 the sub-skills of reading : a. understanding the main idea and supporting details b. reading between the lines : inferential reading c. understanding the writer's point of view d. making predictions e. guessing the meanings of unfamiliar words f. skimming and scanning g. note-making

**UNIT-IV**

**Writing (7hours)**

- 4.1 the importance of writing skills
- 4.2 the differences between speech and writing
- 4.3 the qualities of effective writing : coherence, cohesion, logical structuring and organization, clarity of language, stylistic variation etc.
- 4.4 the writing process : pre-writing, drafting, re-writing

**UNIT-V**

**Soft skill development (5 hours)**

- 5.1 soft skills: becoming a good leader and team-player
- 5.2 inter-relating soft skills and communication skills

**Books Recommended:**

- 1. Business Communication Today by Bovee et al ( Pearson)
- 2. Business Communication by Meenakshi Raman and Prakash Singh (Oxford)
- 3. Crash Course in Personal Development by Brian Clegg ( Kogan Page)
- 4. Activities for Developing Emotional Intelligence by Adele B.Lynn (HRD Press)
- 5. Lateral Thinking by Edward De Bono (Penguin)

**COMMUNICATIVE PRACTICE LAB -II****15PH205      Communication Practice****30 hours****1. Speaking : oral communication in social and 8 hours**

work-related situations, e.g.: Greeting an acquaintance/ friend, introducing oneself, introducing a friend to another friend, breaking off a conversation politely, leave-taking; making and responding to inquiries; expressing an opinion; expressing agreement/ disagreement, contradicting/ refuting an argument; expressing pleasure, sorrow, regret, anger, surprise, wonder, admiration, disappointment etc. Narrating or reporting an event; Describing people, objects, places, processes etc. Ordering / directing someone to do something Making requests; accepting / refusing a request Expressing gratitude; responding to expressions of gratitude Asking for or offering help; responding to a request for help Asking for directions (e.g. how to reach a place, how to operate a device etc.) and giving directions asking for and granting/ refusing permission prohibiting someone from doing something suggesting, advising, persuading, dissuading, making a proposal praising, complimenting, felicitating expressing sympathy (e.g. condolence etc.) Complaining, criticizing, reprimanding

**2. Reading 8 hours**

Students will be given practice in reading and comprehending 6-8 simple passages of 100-300 words each, on topics of general as well as professional interest. The texts will be supported by suitable exercises designed to foster comprehension skills and vocabulary enrichment, together with study skills (note making) and reference skills (using a dictionary). Practice will be provided in the important sub-skills of reading which are introduced in Module 2 of the theory component.

**3. Writing 8 hours**

Writing short paragraphs on given topics or topics of one's choice; social and business letters; reports; applications ; resumes ; summaries The principles of 'Process Writing' should be used to teach writing skills. i pre-writing : generating ideas, brain-storming, idea mapping, outlining ii writing : generating a first draft ; reviewing, redrafting, editing iii post-writing : making a presentation ; discussion and feedback, preparing the final draft

**4. Soft skills practice 6 hours**

Activities designed to highlight leadership and 'team' skills ; Group discussion

**HOSPITAL AND COMMUNITY PHARMACY****15PH206      THEORY****3 hours/week****UNIT – I**

**1. Objectives and Functions, Locations, Organization and Structure:** Organization of a hospital and hospital pharmacy, responsibilities of a hospital pharmacist.

**2. Drug Committees:** Including infection control and ethics committee, Pharmacy and therapeutic Committee, budget preparation and implementation.

**3. Hospital Formulary:** Contents, preparation and revision of hospital formulary.

## UNIT – II

**4. Drug Store Management and Inventory Control:** (a) Organization of drug store, Type of materials stocked, storage conditions. (b) Purchase and Inventory Control principles, purchase procedures, Purchase order, Procurement and stocking.

**5. Drug distribution System in Hospitals:** (a) Outpatient dispensing, methods adopted. (b) Dispensing of drugs to in-patients. Types of drug distribution systems. Changing policy, labeling.

## UNIT – III

**6. Central Sterile Supply Unit and their Management:** Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments, Supply of sterile materials.

**7. Manufacture of Sterile and Nonsterile Products:** Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, master formula card, production control, manufacturing records.

**8. Surgical Products:** Definition, Primary wound dressing, absorbents, surgical cotton, surgical gauzes, bandages, adhesive tape, protective cellulosic hemostastics, dressings, absorbable and nonabsorbable sutures, ligatures and catguts.

## UNIT – IV

**9. Community Pharmacy:** Definition, role of pharmacist in community health care and education. Professional responsibilities of community pharmacist (WHO Model).

**10. Structure of retail and wholesale drug store:** Types of drug store and design. Legal requirements for establishment, maintenance and drug store-dispensing of proprietary products, maintenance of records of retail and wholesale.

## UNIT – V

**11. Over-the counter (OTC) sales:** Rational use of common OTC medications (Vitamins and tonics, iron preparations, analgesics, NSAIDs, cough mixtures, anti-diarrhoeal preparations)

**12. Primary health care in community pharmacy:** Family planning, First aid, participation in primary health programs, Smoking cessation, Screening programs, Nutrition, Responding to common ailments.

**13. First Aid:** Emergency treatment of shock, snakebites, burns, poisoning, fractures and resuscitation methods.

## RECOMMENDED BOOKS:

1. Hassan William E., Hospital Pharmacy (Lea & Febiger, Philadelphia)
2. Nand P., Khar R.K., Text book of Hospital & Clinical Pharmacy (Birla publication, Delhi)
3. Dandiya P.C. & Mathur M., A text book of Hospital & Clinical Pharmacy. (Vallabh Prakashan, Delhi)
4. Role of Pharmacist in the Health care system, WHO/ PHArm/94.569
5. Remington's sciences and practice of Pharmacy; 20th edition Lippin cott. Williams and Welkens.
6. Text Book of Drug Store and Business Management by Jyothi & Ali
7. Text Book of Pharmacy Practice by Leon Shargel.



**3<sup>rd</sup> SEMESTER**

**PHARMACEUTICS-II**  
**(Physical Pharmaceutics - I)**

**15PH301      THEORY**

**3 hours/week**

**UNIT -I**

**1. Matter, Properties of Matter:** State of matter, properties of matter, latent heats, vapour pressure, sublimation, critical point, eutectic mixtures, relative humidity, liquid complexes, liquid crystals, glassy state, crystalline, amorphous, polymorphism, phase equilibrium and phase rule.

**UNIT –II**

**2. Thermodynamics:** Zeroth, first, second and third laws, concept on enthalpy, entropy, absolute temperature scale, Free energy function and applications, Clausius-clapeyron Equation, Van't Hoff equation.

**UNIT -III**

**3. Solutions:** Ideal and real solutions, solution of gases in liquids, colligative properties, partition coefficient, conductance and its measurement. Debye Huckel theory.

**4. Buffers:** Buffer equations and buffer capacity, buffers in pharmaceutical systems, preparation, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

**UNIT -IV**

**5. Solubility & related phenomenon:** Solubility expression, Determination of solubility, Solubility of gases in liquids, Solubility of liquids in liquids, Solubility of solids in liquids.

**6. Complexation:** Classification of complexes, methods of preparation, analysis and applications.

**UNIT –V**

**7. Kinetics and Drug Stability:** General considerations & concepts, half-life determination, Influence of temperature, light, solvent, catalytic species, Accelerated stability study, determination of expiry date.

**PHARMACEUTICS-II**  
**(Physical Pharmacy - II)**

**PRACTICAL**

**3 hours/ week**

**(A minimum of 15 experiments shall be conducted)**

1. To study phase behaviour of three component system and construct ternary phase diagram
2. Determination of upper critical solution temperature phenol water system
3. To determine molar mass by Rast method and cryoscopic method.
4. To determine the partition coefficient (e.g. benzoic acid between distilled water and benzene)
5. To verify Ostwald dilution law and perform conductometric titration
6. Preparation of pharmaceutical buffers and determination of buffer capacity
7. To determine dissociation constant of weak acid or weak base
8. To determine the heat of solution of a substance by solubility method
9. To determine the solubility of a substance in different solvent
10. Determination of half-life, rate constant and order of reaction.
11. Other experiments based on theory

**RECOMMENDED BOOKS:**

1. Martin's Physical Pharmaceutical Sciences by P.J.Sinko (Lippincott William and Wilkins, Baltimore)
2. Cooper and Gunn's Tutorial Pharmacy edited by S.J. Carter
3. Bently's Textbook of Pharmaceutics edited by E.A. Rawlins

**PHARM. ENGINEERING-I**

(Unit Operations – I)

15PH302      THEORY

3 hours/ week

**UNIT -I**

**1. Heat Transfer:** Heat transfer, overall heat transfer coefficient, sources of heat, steam and electricity as heating media, determination of requirement of amount of steam/ electrical energy, steam pressure, heat exchangers and **heat interchangers, Radiation, black body, Grey body, Stefan Boltzmann equation, Kirchoff's law, application of Fourier's law, Forced and natural circulation and their application.** A few numerical problems may be solved.

**2. Drying:** Moisture content and mechanism of drying, rate of drying and time of drying calculations. Classification and types of dryers, dryers used in pharmaceutical industries with special reference to Fluidised bed dryer, spray dryer, freeze dryer, vacuum dryer, tray dryer etc. A few numerical problems may be solved.

**UNIT -II**

**3. Size Reduction and Size Separation:** Definition, objectives of size reduction and size separation, factors affecting size reduction, laws governing energy and power requirements of mills including ball mill, hammer mill, fluid energy mill, sieve analysis, standards of sieves, size separation equipment shaking and vibrating screens, gyratory screens, cyclone separator, air separator, bag filters, cottrell precipitator, scrubbers, size separators basing on sedimentation theory. A few numerical problems may be solved.

**UNIT -III**

**4. Mixing and Homogenization:** Theory of mixing, mixing efficiency, Factors influencing mixing, solid-solid, solid-liquid and liquid-liquid mixing equipments, homogenizers such as **Sigma blade mixer, Planetary mixer, Airjet mixer, jet mixer, Silverson mixer-emulsifier and triple roller mixer.** A few numerical problems may be solved.

**UNIT -IV**

**5. Distillation:** Raoult's law, phase diagrams, volatility, simple, steam and flash distillations, principles of rectification, McCabe Thiele method for calculation of number of theoretical plates, Azeotropic and extractive distillation. A few numerical problems may be solved.

**UNIT-V**

**6. Evaporation:** Basic concept of phase equilibria, factors affecting evaporation, evaporators, film evaporator, single effect and multiple effect evaporator, **Mathematical problems on evaporation.**

**7. Filtration:** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter. Factors affecting filtration, optimum cleaning cycle on batch filters. A few numerical problems may be solved.

**PHARMACEUTICAL CHEMISTRY-III**

(Organic Chemistry-II)

15PH303      THEORY

3 hours/ week

**UNIT –I**

**Stereochemistry:**

**Isomerism:** Different types of isomerism, their nomenclature and associated physicochemical properties, Structural Isomerism: Chain isomerism, Positional isomerism, Functional isomerism and Metamerism, Keto-Enol tautomerism.

**Conformational Isomerism:** Conformations of Ethane and Butane.

**Geometrical Isomerism:** Cis-Trans Isomers and E-Z Isomers, Physical and Chemical properties, Stability of Cis and Trans Isomers.

## UNIT –II

### Optical Isomerism:

Optical activity, Specific rotation, Asymmetric carbon, Chirality, Fischer projection, Enantiomerism, Diastereoisomerism.

Specification of configuration:

Absolute and Relative configuration (D, L system and R, S system).

External and Internal compensation, Racemic mixture and Resolution of racemic mixture, Racemization, Walden inversion.

Stereoselective and stereospecific reactions

## UNIT –III

**Benzene and its homologues:** Structure of benzene, Resonance, Aromatic character, Huckel Rule. General methods of preparation, Physical properties, Chemical properties: Electrophilic substitution reactions, Friedel crafts reaction, Catalytic hydrogenation.

Orientation of aromatic substitution in mono-substituted benzene

**Phenols:** General methods of preparation, Physical and Chemical properties

## UNIT –IV

**Polynuclear Aromatic Hydrocarbons:** Preparation and chemical reactions of anthracene and phenanthrene.

**Heterocyclic compounds:** Nomenclature, preparation and some important reaction of- Furan, Pyrrole, thiophen, indole, imidazole, pyridine, isoquinoline.

## UNIT –V

Organic reagents used in drug synthesis e.g., Aluminium tert-butoxide, Lithium Aluminium Hydride, N-Bromo-succinimide (NBS), Diazomethane.

## PHARMACEUTICAL CHEMISTRY-III

### (Organic Chemistry-II)

#### PRACTICAL

3 hours/ week

(A minimum of 15 experiments shall be conducted)

1. Preparation of organic compounds and their derivatives, crystallization and determination of their melting points (minimum three).
2. Estimation of organic compounds using functional groups (minimum three).
3. At least four experiments on analysis of organic compounds containing two functional groups

#### RECOMMENDED BOOKS:

1. Organic Chemistry by R.T. Morrison and R.N. Boyd. (Prentice Hall of India, New Delhi)
2. Advanced Organic Chemistry by B.S. Bahl and Arun Bahl. (S. Chand, New Delhi)
3. Bentley and Driver's Text Book of Pharmaceutical Chemistry. (Oxford University Press, New Delhi)
4. Organic Chemistry – Reactions and Reagents by O.P. Agarwal. (Krishna Prakashan, Meerut)
5. Organic Chemistry by I.L. Finar Vol. I & Vol. II. (Longman, Singapore)

**PHARMACOGNOSY – II**

**15PH304      THEORY**

**3 hours/week**

**MODULE-I**

**1. Volatile Oils:** General methods of extraction of volatile oils from plants, Study of biological source, chemical constituents, chemical tests and uses of volatile oils of Mentha, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Nutmeg, Chenopodium, Valerian, Musk, Palmarosa, Gaultheria.. Detailed Pharmacognosy of Clove, Coriander, Fennel, Sandal wood, Cardamom, Cinnamon and Eucalyptus.

**MODULE-II**

**2.** Historical perspectives, prospects for development of plant biotechnology as source of medical agents. Applications in pharmacy and allied fields.

**MODULE-III**

**3.** Natural allergens and photosensitizing agents.

**4.** Antioxidants from plant origin. i.e. Ginkgo biloba, Green Tea, Garlic, momordica, Tomata.

**MODULE-IV**

**5. Fibres:** Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos.

**MODULE-V**

**6. Pharmaceutical aids:** Study of pharmaceutical aids like talc, diatomite, kaolin, bentonite, gelatin and natural colors (Turmeric, Saffron, Anato, Caramel, Cocheneal).

**RECOMMENDED BOOKS:**

1. Text Book of Pharmacognosy by Kokate C K, Purohit A P, Gokhale S B (Nirali Prakashan, Pune)
2. Trease G.E. and Evans W.C., Pharmacognosy (Bailliere Tindall, Eastbourne)
3. Text Book of Pharmacognosy by T.E.Wallis.(CBS Publishers, New Delhi)
4. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)
5. Rangari V D., Text book of Pharmacognosy Vol-I & II.
6. Text Book of Pharmacognsy by S.S.Honda,, V.K Kapoor
7. Text Book of Industrial Pharmacognsy by A. N. Kalia

**PHARMACOGNOSY – II**

**PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

**1-4** Identification of crude drugs mentioned in theory (at least 5)

**6-7.** Study of fibres

**8-9.** Study of pharmaceutical aids.

**10-14.** Microscopic studies of four selected crude drugs and their powders mentioned in theory and their chemical tests.

**15-17.** Identification of plant constituents by TLC methods.

**PATHOPHYSIOLOGY OF COMMON DISEASES**

**15PH305      THEORY**

**3 hours/ week**

**UNIT -I**

**1. Basic Principles of Cell Injury and Adaptation :** Causes of Cellular injury, 5pathogenesis, morphology of cell injury, intercellular alterations in lipids, proteins and carbohydrates, Cellular adaptations, atrophy, hypertrophy, hyperplasia, metastasis & dysplasia.

**UNIT - II**

**2. Basic Mechanisms involved in the process of inflammation and repair :**

Alteration in vascular permeability and blood flow, migration of WBCs, acute and chronic inflammation, mediators of inflammation, brief outline of the process of repair.

**UNIT -III**

**3. Pathophysiology of CVS Disorders:**, Hypertension, angina, congestive heart failure, atherosclerosis, myocardial infarction.

**Pathophysiology of CNS Disorders:** Rheumatoid arthritis, gout, epilepsy, psychosis, depression, mania

**UNIT -IV**

**4. Pathophysiology of Endocrine Disorders:** Diabetes and other disorders.

**Pathophysiology of GI Diseases:** Peptic ulcer asthma, ulcerative colitis.

**Hepatic disorders** like jaundice, viral hepatitis, hepatocellular carcinoma, cirrhosis & portal hypertension

**UNIT -V**

**5. Pathophysiology of Respiratory Diseases:** Asthma.

**Pathophysiology of Infectious Diseases:** Tuberculosis, urinary tract infections, sexually transmitted diseases, acute and chronic renal failure, anemias and common types of neoplasms like carcinoma of lung, skin cervix, colon & brief outline on different types of leukemias. Wherever applicable the molecular basis should be discussed.

**RECOMMENDED BOOKS:**

1. Pathologic basis of diseases by Robbins S.L. (Harcourt India, New Delhi).
2. Pathology Quick Review and MCQs based on Harsh Mohan's Text Book of Pathology (Jaypee brothers medical publishers, New Delhi)

**ENVIRONMENTAL SCIENCE**

**15PH306      THEORY**

**2 hours/week**

**UNIT – I**

**1. Introduction to Environment, Ecological Concepts:** Principle, components, Ecosystem Process: Energy, Food Chain, Air cycle etc., Atmospheric chemistry and Soil chemistry

**2. Concept in Hydrology:** Hydrological cycle, Precipitation, Infiltration, evaporation and evapotranspiration, Rainfall-runoff relationships.

**UNIT – II**

**3. Water Pollution:** Physical and chemical properties of water, water quality standards and parameters.

**4. Water Treatment:** Pre-treatment of water, Conventional process, and advanced water treatment process.

**5. Waste Water Treatment:** Pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion and its application.

**UNIT – III**

**6. Solid Waste Management:** Sources classification and composition of MSW; properties and separation, storage and transportation, Biological treatment, Thermal treatment, Landfill etc.

7. Hazardous Waste Management: Sources and classification of Hazardous waste including Medical hazardous waste and Household waste, Management of hazardous waste: Storage, collection and transportation, treatment and disposal.

**UNIT – IV**

8. Air Pollution: Air pollution and types of air pollutants, Acid deposition, Global climate change - green house gases.

9. Noise Pollution: Physical Properties of sound, Noise criteria, Noise Standards, Noise measurement, Noise control.

**UNIT – V**

10. Waste Minimization: Concept, benefits of waste minimization, Elements of waste minimization programme, Waste reduction techniques. Life Cycle Assessment, Environment Impact Assessment, Origin and procedure of EIA, Project Screening of EIA, Scope studies, Preparation and review.

**4<sup>th</sup> SEMESTER**

**PHARMACEUTICS-III**

**Physical Pharmaceutics – II**

**15PH401      THEORY**

**3 hours/week**

**UNIT -I**

**1. Micromeritics and powder Rheology :** Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle size, volume, shape, surface area, specific surface, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

**UNIT -II**

**2. Rheology :** Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, Newtonian and non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling sphere, rotational viscometers.

**UNIT -III**

**3. Surface and Interfacial Phenomenon :** Liquid interface, surface and interfacial tensions, surface free energy, measurement of surface and interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid-gas and solid-liquid interfaces, complex films, electrical properties. Freudlich and Gibbs adsorption isotherms, Langmuir theory of adsorption, BET equation.

**UNIT –IV**

**4. Colloidal Dispersion Systems:** Colloidal dispersions, types, optical, kinetic and electrical properties of colloids, protective colloids, applications of colloids in pharmacy;

**UNIT –V**

**5. Coarse Dispersion Systems :**

Suspensions: Interfacial properties of suspended particles, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, Emulsions: theories of emulsification, physical stability and rheological considerations.

**PHARMACEUTICS-III (Physical Pharmacy – II)**

**PRACTICAL      3 hours/ week      (A minimum of 15 experiments shall be conducted)**

1. Determination of particle size and particle size distribution using various methods of particle size analysis (optical microscopy, sieving and sedimentation).
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. To determine viscosity of liquid using Ostwald viscometers.
4. To determine viscosity of liquid using Brookfield viscometers
5. To determine surface tension of different liquid using Ostwald stalgmometer.
6. To determine interfacial tension between two liquid using Ostwald stalgmometer
7. Determination of HLB value of different surfactant
8. To determine critical micellar concentration of surfactants using Ostwald stalgmometer

9. Preparation of various types suspensions and determination of their sedimentation parameters.
10. Preparation and stability studies of emulsions.
11. Other experiments based on theory

**RECOMMENDED BOOKS:**

1. Martin's Physical Pharmacy & Pharmaceutical Sciences by P.J.Sinko. (Lippincott Williams and Wilkins, Baltimore)
2. Cooper and Gunn's Tutorial Pharmacy edited by S.J. Carter (CBS Publishers, Delhi)
3. Bentley's Textbook of Pharmaceutics edited by E.A. Rawlins (All India Traveler Book Seller, New Delhi)

**PHARM. ENGINEERING-II**

**15PH402      THEORY**

**3 hours/week**

**UNIT -I**

1. **Fluid Flow:** Type of flow, Reynold's number, Viscosity, concept of boundary layer, basic equations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure. Application of fluid flow. A few numerical problems may be solved.
2. **Dehumidification and Humidity Control:** Basic concepts and definition, wet bulb and adiabatic saturation temperature, psychrometric chart and measurement of humidity, application of humidity, measurement in pharmacy, equipments of dehumidification operations.

**UNIT -II**

**3. Material Handling Systems:**

Liquid handling – different types of pumps.

Gas handling – various types of fans, blowers and compressors.

Solid handling – Conveyers

**UNIT -III**

4. **Crystallization:** Characteristics of crystals like – purity, size shape, geometry, habit, forms size and factors affecting them. Solubility curves and calculation of yields, material and heat balances around Swenson Walker Crystalizer. Supersaturation theory and its limitations, nucleation mechanisms, crystal growth, study of various types of crystallizer, tanks, agitated batch, Swenson Walker, single vacuum, circulating magma and Krystal crystallizer, caking of crystals and its prevention, numerical problems on yields.

**UNIT -IV**

5. **Materials of Construction:** General study of composition, corrosion, resistance, properties and applications of materials of construction with special reference to stainless steel and glass.
6. **Industrial Hazards and safety Precautions:** Mechanical, Chemical, Electrical, fire and dust hazards, industrial dermatitis, accident records etc.

**UNIT -V**

7. **Centrifugations:** Principles of centrifugation, **classification of centrifuges** industrial centrifugal filters and centrifugal sedimenters such as **perforated basket centrifuge, semi-continuous centrifuge, super centrifuge, De laval clarifier.**

**RECOMMENDED BOOKS:**

1. Cooper and Gunn's Tutorial Pharmacy Edited by S.J.Carter (CBS Publishers, Delhi)
2. Pharmaceutical Engineering by K.Sanbamurty (New Age International, New Delhi)
3. Chemical Engineering by Badger and Banchero (Mc Graw Hill, New Delhi)



4. Pharmaceutical Dosage forms by Aulton.(Churchill Livingstone, Edinburg)
5. Pharmaceutical engineering(principles and practice) by C.V.S. Subramanyam,J. Thimma Setty,Sarasija Suresh,Mrs V.Kusum Devi

**Pharm. Engineering-II**

**PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Determination of rate of evaporation.
2. Determination of overall heat transfer coefficient.
3. Experiments based on steam, extractive and azeotropic distillations.
4. Experiments based on determination of radiation constant.
5. Experiments based on sieve analysis.
6. Experiments based on size reduction using ball mill
7. Experiments to illustrate the influence of various parameters on the rate of drying.
8. Measurement of flow of Determination of rate of drying, free moisture content and bound moisture content.
9. Experiments to illustrate solid – solid mixing, determination of mixing efficiency using different types of mixers.
10. Fluids and their pressure, determination of Reynolds number.
11. Determination of humidity – use of Dry Bulb and Wet Bulb temperatures and Psychrometric charts.
12. Experiments to demonstrate applications of centrifugation.
13. Experiments based on crystallization.
14. Other experiments based on theory.

**BIOCHEMISTRY**

**15PH403      THEORY**

**3 hours/week**

**UNIT -I**

1. Biochemical organization of the cell and transport processes across cell membrane. Outlines of biochemistry of cell division and metastasis.
2. The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.

**UNIT -II**

3. Enzymes: Nomenclature, factors affecting enzyme action, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.
4. Co-enzymes: Vitamins as co-enzymes and their significance, metals as co-enzymes and their significance.

**UNIT -III**

5. Carbohydrate Metabolism: Chemistry of Carbohydrates, Glycolysis and fermentation and their regulation, Gluconeogenesis, Glycogenolysis, Glycogenesis, and Pentose phosphate Pathway.
6. The Citric Acid Cycle:Significance, reactions and energetic of the cycle, Amphibolic role of the cycle and Anaplerosis.

#### UNIT -IV

7. Lipid Metabolism: Chemistry of lipids & Fats, Oxidation of fatty acids;  $\beta$ -oxidation & 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 & Bio synthesis of eicosanoids (prostaglandins, thromboxanes and leukotrienes), phospholipids and sphingolipids.

#### UNIT-V

8. Chemistry of Proteins and Nucleic acids: Outlines of the mechanism of protein and nucleic acid synthesis and catabolism. Principles of biological oxidation and detoxification mechanisms.

### BIOCHEMISTRY

#### PRACTICAL

3 hours/week

**(A minimum of 15 experiments shall be conducted)**

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
2. Colorimetric estimation of blood glucose.
3. Estimation of cholesterol, creatinine, urea and uric acid in biological fluids.
4. Qualitative test for normal and abnormal constituents of urine.
5. Estimation of reducing sugars in urine.
6. Estimation of bilirubin content the blood.
7. Enzymatic hydrolysis of glycogen by alpha and beta amylases.
8. Effect of temperature on the activity of alpha amylases.
9. Estimation of Blood Cholesterol
10. Estimation of SGOT, SGPT by UV Spectrophotometer.
11. Estimation of serum alkaline phosphate and acid phosphatase levels.
12. Estimation of serum sodium, potassium and calcium levels.

#### RECOMMENDED BOOKS:

1. Harper's Biochemistry R.K.Murray and Others (Prentice Hall of India, New Delhi)
2. Biochemistry by Stryer. (W.H. Freeman, New York)
3. Text Book of Biochemistry by West & Todd (Oxford & IBH Pub., Co., New Delhi)
4. Fundamentals of Biochemistry by Dr.A.C.Deb (New Central Book Agency, Calcutta)
5. Text Book of Biochemistry by Dr.A.V.S.S.Rama Rao (UBS Publishers & Distributors, New Delhi)
6. Text Book of Biochemistry by Dr.Satyanarayana

## COMPUTER APPLICATIONS

15PH404      Theory

3 Hours/week

### UNIT-I

**Introduction:** Introduction computer, Generation and Classifications of computer (According to size and use)

**Hardware:** Architecture of a micro computer, CPU, ALU, Internal memory (RAM & ROM), various peripheral devices such as Input devices, Output devices, Storage devices. Various ports and slots such as PCI, Parallel, Serial, PS/2, USB etc.

**Number System:** Binary, Octal and Hexadecimal Number Systems. Addition and subtraction binary numbers (1's & 2's complement method)

**Software:** Introduction to software. Different computer languages (such as Machine, Assembly and High-level languages). Classification of application software according their use.

### UNIT-II

**Operating Systems:** Introduction to various operating systems, Different Type of file manipulation and storage management such as Directory/folder handling, Copy, moving , deleting, searching etc of files. Various storage maintenance tasks such as Checking, Scanning, and Formatting storage device (eg. HDD or Pen drive, DVD etc) by using the Windows-XP & Linux

**Application of Computers in Pharmacy:** Various use of computer in pharmaceutical research and development, industries, education and hospitals.

### UNIT-III

#### Programming with JAVA

**Introduction to programming:** Problem Analysis, algorithm, flow chart, coding, execution, debugging & testing and programming documentation.

**Introduction to JAVA:** History of Java, Introduction to OOP. Idea about class and objects, Java program structure, Java tokens and key words, identifiers, variables & constants, data types, declaration & initialization of variables, Operators and expressions, writing and running simple Java programmes using BlueJ.

### UNIT- IV

**Control statements:** Decision making by using if, if...else, nested if..else, Switch..case statement. Looking statements like while, for, do while statements.

**Input and output in Java:** Input the values by using, Scanner & Buffered Reader. Output the data by using print ln() method etc. Exception handling (simple cases only).

**Java Methods(functions):** Definition, declarations and calling of Java methods, discussion about library methods(functions) to handle mathematical, character, string, date & time problems.

**Array:** Introduction to array, Declaration & use of 1-D and 2-D array. Sorting and searching in 1-D array.

### UNIT-V

**Computer Networking:** Introduction to Computer networking, Mode of transmission (simplex, duplex, Half-duplex). Classification of networking like LAN, MAN & WAN. Network topologies, Network protocols, OSI layers.

**Internet:** Introduction to internet, TCP/IP, Internet browsers, URL. Introduction to e-mail and its use. Important websites related to pharmaceutical information –like sites for information regarding drugs, medical literature, plants, clinical data, patent sites, FDA, WHO etc.

**RECOMMENDED BOOKS:**

Computer Fundamentals, P.K.Sinha, BPB Publications

Computer Applications in Pharmacy -William and Fassett

The ABC's of the Internet - Cristain Crumlish, BPB Publications, N. Delhi – 01

PROGRAMMING WITH JAVA - E Balagurusamy, Amazon India

**COMPUTER APPLICATIONS (PRACTICAL)**

1. Demonstration of computer hardware.
2. Operating system: Windows & Linux Understanding the sub-directories/folders, copying, moving, deleting & searching of files/folders etc
3. MS-WORD: Create and save a document in Ms-word, text editing, text formatting.
4. MS-EXCEL: Understanding a work sheet, Create and save a work-book file. Input various values of data types into a worksheet cell, using of formulas & functions and plotting of graph using Excel
5. Write Simple Java programmes in BlueJ Environment: At least 10 programmes should be developed in order to learn use of conditional statements, looping statements, Java methods, Array etc.
6. Preparing a presentation by using Power Point.
7. Use of Internet: Use of various search engines, creation and use of e-mail id and groups.

**RECOMMENDED BOOKS:**

1. Computer Fundamentals, P.K.Sinha, BPB Publications
2. Fundamentals of Computers, V. Rajaraman, Prentice Hall of India Pvt. Ltd., 1986.
3. Computer Applications in Pharmacy -William and Fassett -
4. The ABC's of the Internet - Cristain Crumlish, BPB Publications, N. Delhi – 01
5. Programming with Java - E Balagurusamy, Amazon India
6. Complete Reference MS- Office
7. Complete Reference Windows XP.
8. Complete Reference Internet

**ORGANIC CHEMISTRY-III**

15PH405      THEORY

3 hours/week

**UNIT-I**

**Heterocyclic Compounds Containing Two Hetero Atoms**

Nomenclature, Synthesis, reaction and medicinal uses of following compounds Pyrazole, Benzimidazole, Oxazole, thiazole, pyrimidine, purine and phenothiazine.

**UNIT-II**

**Carbohydrates:** Classification, reducing and non-reducing sugars, chemistry (Excluding structure elucidation) of glucose, fructose, starch and cellulose,

**Lipids** (Fats and Oils): Classification and structure, physical and chemical properties (saponification, Hydrogenation, oxidation) analysis of (acid value, iodine value, saponification value, Reichert-Meissl value).

**UNIT-III**

**Amino acids and Proteins:** Structure of commonly occurring amino acids, Synthesis of amino acids and their physical properties and some characteristic chemical reactions, classification of proteins, physical properties, purification of proteins, concept of polypeptides.

**Nucleic acids:** Nucleic acids and their components: DNA & RNA bases, Nucleosides, Nucleotides, structure, of RNA & DNA. Types of RNA: m- RNA, t-RNA & r-RNA. Function of DNA & role in protein synthesis

**UNIT-IV**

**Study the following reactions with mechanism.**

Benzoin condensation reaction, Reformatsky reactions, Beckmann rearrangement, Michael addition, Mannich reaction, Oppenaur oxidation, Claisen condensation, Knoevenagel condensation, Perkin reactions and their applications.

**UNIT-V**

**Pericyclic Reaction:**

**Electrocyclic:** Pericyclic rearrangement, Thermal reactions of HOMO and LUMO

**Cycloaddition:** Woodward–Hoffmann rules for electrocyclic reactions, Diels – Alder reaction.

**Sigmatropic reactions:** Cope rearrangements, Claisen rearrangements

**MATHEMATICS AND STATISTICS****15PH406      THEORY****3 hours/week****UNIT -I**

Integration:- Integration as inverse process of differentiation, Definite integrals (simple cases). Integration by (i) Decomposition (ii) by substitution (iii) by parts. Integration of Logarithmic, Trigonometric, Algebraic and exponential functions.

**UNIT -II**

Differential Equations:- Introduction to differential equations, Formation of different equations, Solution of differential equations of first order and first degree by the methods of variable separable, Homogeneous, reducible to homogeneous and linear equations, Reducible to linear equations, Exact differential equations. Differential equations of order greater than one with constant coefficients, Pharmaceutical applications.

**UNIT -III**

Laplace transforms : Theorem, properties and uses (problems)

**UNIT -IV**

Statistics -I:- Introduction to statistics, Data collection random and non-random sampling methods, Sample size, Diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, Measures of central tendency, Measures of dispersion, Standard deviation, Measures of skewness, Measures of kurtosis, Correlation and regression analysis, Methods of least squares, Probability and events, Probability theorems, Baye's Theorem on probability.

**UNIT -V**

Statistics- II:- Probability Distributions – Binomial, Poisson and normal distributions (normal curve and properties), Tests of hypothesis (statistical inference) Standard error, Fiducial (confidence) limits, Tests of significance for small samples- Student's t-distribution and t-tests, Paired t-test, chi-square tests and F-test (Pharmaceutical applications).

**RECOMMENDED BOOKS:**

1. Integral Calculus by Shanti Narayan.
2. Statistical Methods by S.P. Gupta. (S. Chand, New Delhi)
3. Higher Engineering Mathematics by B.S. Grewal. (Khanna Publishers, Delhi)
4. Mathematical Methods by Potter & Gold Berg. (Prentice Hall of India, New Delhi)

**5<sup>th</sup> SEMESTER**

**PHARMACEUTICS-II**  
**(Pharmaceutical Technology-I)**

**15PH501**

**THEORY**

**3 hours/week**

**UNIT -I**

**Preformulation Studies : Principal areas like**

- a. Bulk Characterization : Crystallinity and Polymorphism, Co pressibility hygroscopicity, bulk density, powder flow properties.
- b. **Solubility analysis: pKa, pH solubility profile, Common ionic effect, thermal effects, solubilization partition coefficient and dissolution.**

**UNIT -II**

**Liquid Dosage Forms:** Introduction, types of additives used in formulations, Vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizer, colors, flavours and others, manufacturing, packaging and evaluation of clear liquids, suspensions and emulsions.

**UNIT -III**

**Semisolid Dosage Forms:** Definitions, types, mechanisms of drug permeation, factors influencing permeation, semisolid bases and their selection. General formulation of semisolids: like ointments, creams, pastes & gels, their manufacturing procedure, evaluation and packaging.

**Suppositories:** Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

**UNIT -IV**

**Tablets:** Types of tablets, excipients used, and different granulation techniques used for preparation of tablets, types of tablet press, manufacturing defects and evaluation of tablets. Coating of tablets : Type of coating – Sugar coating, film coating, enteric coating, film defects, materials used and evaluation of coated tablets. Discussion on new materials such as superdisintegrants, equipments like rapid mixers, granulators, fluid bed dryer.

**UNIT –V**

**Capsules:** Advantages and disadvantages of capsule dosage forms, materials used for production of hard gelatin capsules, different sizes of capsules, methods of capsule filling, Soft gelatin capsules, capsule shell and content of capsules, importance of base absorption and minim/gm. Quality control and storage of capsule dosage forms.

**RECOMMENDED BOOKS:**

1. Bently's Textbook of pharmaceuticals edited by E.A. Rawlins (All India Traveller Book Seller, New Delhi)
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig (Varghese Pub. House, Bombay)
3. Pharmaceutical Dosage Forms and Drug Delivery Systems by Ansel, Allen and Popovich (B. I. Waverly Pvt. Ltd., New Delhi)
4. REMINGTON: The Science and Practice of Pharmacy, 20<sup>th</sup> Edition (Lippincott Williams & Wilkins, Baltimore)
5. Pharmaceuticals: The Science of Dosage Form Design by Aulton (Churchill Livingstone, Edinburgh)

**PHARMACEUTICS-II**  
(Pharmaceutical Technology – I)

**PRACTICAL**

**3 hours / week**

**(A minimum of 15 experiments shall be conducted)**

1. Preparation and evaluation of different types of syrup.
2. Preparation and evaluation of elixirs.
3. Preparation and evaluation of oral rehydration solutions.
4. Preparation and evaluation of different types of suspension such as flocculated, deflocculated suspension, dry suspension, suspensions based on high and low solid content etc.
5. Preparation and evaluation of emulsions by HLB method.
6. Preparation and evaluation of ointment by using different types of base.
7. Preparation and evaluation of creams, gels and pastes.
8. Preparation and evaluation of suppositories by using different base.
9. Granulation by different methods (wet granulation, dry granulation)
10. Preparation of different types of tablets.
11. Evaluation of tablets.
12. Preparation of coated tablets (sugar coating, film coating)
13. Evaluation of film coated and enteric coated tablets.
14. Filling and evaluation of hard gelatin capsules.

**MEDICINAL CHEMISTRY – I**

**15PH502**

**THEORY**

**3 hours/ week**

**UNIT -I**

1. **Basic Principles of Medical Chemistry:** Physico-chemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action
2. **Brief concept on QSAR: Hansch analysis** – its derivation and discussion on different parameters like electronic parameters, steric factor, and partition coefficient. Free Wilson model.  
**Virtual drug screening techniques and its applications.**  
**3-D QSAR Analysis:** Receptor independent 3-D QSAR Analysis, Receptor dependent 3-D QSAR Analysis

**UNIT -II**

Classification, mode of action, uses and structure activity relationship of the following classes of drugs.  
Synthesis of those compounds only exemplified against each class.

**A. Drugs acting on autonomic nervous system:**

- **Cholinergics and Anticholinesterase:** Acetylcholine, Carbachol, Bethanechol, methacholine and Neostigmine.
- **Adrenergic drugs and adrenergic blocking agents:** Adrenaline, Salbutamol, Naphazoline, Propranolol, Atenolol
- **Antispasmodic and anti ulcer drugs:** Homatropine, Cyclopentolate, Diclofenac, Tropicamide.
- **Neuromuscular blocking agents:** Gallamine, succinylcholine



**UNIT -III**

**B. Autacoids :**

- **Antithistamines:** Diphenhydramine, Mepyramine, Chlorpheniramine, Promethazine, Chlorcyclizine, Ranitidine.
- **Eicosanoids :** Occurrences, Chemical nature, Medicinal applications
- **Analgesic – antipyretics, anti-inflammatory (non-steroidal) agents:** Aspirin, Paracetamol, Ibuprofen, Naproxan, Diclofenac sodium.

**UNIT -IV**

**Diuretics:** Acetazolamide, Chlorthiazide, Furosemide,

**Cardiovascular drugs:** Clonidine, Methyldopa, Procainamide, Nifedipine, Prazocin, clofibrate.

**UNIT -V**

**Anti-TB and anti-leprosy Drugs:** Isoniazid, Ethambutol, Pirazinamide, Dapsone

**Antiamoebic agents:** Metronidazole, Diloxamide furoate

**Anthelmintics :** Thiabendazole, Mebendazole, Niclosamide

**Diagnostic Agents:** Propylidone, Sodium diatrizoate, Fluorescein sodium.

**PHARMACEUTICAL CHEMISTRY-V**  
**(Medicinal Chemistry – I)**

**PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Synthesis of selected drugs and intermediates from the course content.
2. Monographs of selected official drugs including identification tests and tests for purity.

**RECOMMENDED BOOKS**

1. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry.
2. Principles of Medicinal Chemistry by William O.Foye.
3. A Text Book of Medicinal Chemistry by S.N.Pandeya.
4. Medicinal Chemistry by Ashutoshkar.
5. Bentley's and Driver's Text Book of Pharmaceutical Chemistry.
6. Introduction to Medicinal Chemistry by Graham L. Patrick

**PHARMACEUTICAL ANALYSIS-II**

**15PH503**

**THEORY**

**3 hours/ week**

**UNIT -I**

**1. Gravimetric Analysis:** Precipitation techniques, solubility products. The colloidal state, supersaturation, co-precipitation, post precipitation, Digestion, washing of the precipitate, Filtration, Filter papers, and crucibles, Ignition. Thermo gravimetric curves, specific examples like barium sulphate, aluminum as aluminum oxide, calcium as calcium oxalate and magnesium as magnesium pyrophosphate, organic precipitants.

**UNIT -II**

1. Potentiometry and pH Meter

2. Conductometry

**UNIT -III**

1. Polarography and Amperometry
2. Nephelometry and Turbidimetry.

**UNIT -IV**

1. Diazotisation titrations, Kjeldahl method of nitrogen estimation,
2. Karl-Fischer titration, Oxygen flask combustion gasometry.

**UNIT-V**

1. Radioimmuno Assays.
2. Electrophoresis

**PHARMACEUTICAL ANALYSIS-II**

**15PH503**

**PRACTICAL**

**3 hours/ week**

**(A minimum of 15 experiments shall be conducted)**

1. Exercise involving diazotization, Kjeldahl, Karl-Fischer, shall be covered.
2. Exercises based on acid base titration in aqueous and non-aqueous media,
3. Oxidation reduction titrations using potentiometric technique.
4. Determination of acid-base dissociation constants and plotting of titration curves using pH meter.
5. Exercises involving conductometric titrations.

**RECOMMENDED BOOKS:**

1. Vogel's Text Book of Quantitative Chemical Analysis.
2. Practical Pharmaceutical Analysis by Beckett and Stenlake Vol. I & II.
3. Indian Pharmacopocia Vol. I & II 46
4. Instrumental methods chemical analysis by B.K. Sharma 5. Bently and Driver's Text Book of Pharmaceutical Chemistry

**PHARMACOLOGY-I**

**15PH504**

**THEORY**

**3Hrs/Week**

**UNIT-I**

**1. General Pharmacology:**

- 1.1. Introduction to pharmacology, Source of Drug, Routes of administration with special reference to its advantages and disadvantages.
- 1.2. Pharmacokinetics: Absorption, factors affecting drug absorption, distribution, metabolism and excretion of drug.
- 1.3. Pharmacodynamics: General principle and molecular aspects of drug action with special emphasis on receptors, receptor classification, Drug-receptor interaction, potentiation, antagonism phenomenon.

**UNIT-II**

**2. Pharmacology of drugs acting on peripheral (autonomic) nervous system:**

- 2.1. Neurohumoral transmission of autonomic nervous system.
- 2.2. Drugs acting on cholinergic system: Cholinergic drugs (parasympathomimetic), Anticholinergic drugs (parasympatholytic).
- 2.3. Drugs acting adrenergic system: Adrenergic drugs (sympathomimetic), Adrenergic blocking drugs (sympatholytic).
- 2.4. Drugs acting on autonomic ganglia: Ganglion stimulant and Ganglion blocking agent.

**UNIT-III**

**3. Pharmacology of drugs acting on peripheral (somatic) nervous system:**

- 3.1. Neurohumoral transmission of somatic nervous system.
- 3.2. Neuromuscular blocking agent and peripherally acting skeletal muscle relaxant.
- 3.3. Local anesthetics.

**UNIT-IV**

**4. Pharmacology of drugs acting on central nervous system:**

- 4.1. Neurohumoral transmissions in CNS with special emphasis on neurotransmitters like serotonin, dopamine, GABA, Glutamate.
- 4.2. General anesthetics.
- 4.3. Sedative and hypnotics, centrally acting muscle relaxants.
- 4.4. Anti-epileptics.
- 4.5. Opioid analgesics and antagonist.
- 4.6. Nootropic agents.

**UNIT-V**

**5. Psychopharmacological agents:**

- 5.1. Antipsychotics/Neuroleptics.
- 5.2. Antidepressant and anti-manic drugs.
- 5.3. Antiparkinsonian drugs

**PHARMACOLOGY-I**

**15PH504**

**PRACTICAL**

**3 hours/ week**

1. Commonly used laboratory instruments, laboratory animals in experimental pharmacology, dose calculation and study of different routes of administration of drugs in rat/mice. (01Experiment)
2. Commonly used anesthetics used in animal study, some common and standard laboratory techniques like procedure for rendering animal unconscious, blood withdrawal and plasma serum separation. (01 Experiment)
3. Effects of various agonist and antagonist and their characterization using isolated tissue preparations like frog's rectus abdominis muscle, isolated ileum preparation of rat and isolated fundus strip preparation of rat. (03 Experiment)
4. Experiment to explain the concept of reversible antagonism using suitable isolated tissue preparation.( 01 Experiment)
5. Experiment to explain the role of choline esterase enzyme and its inhibitor using suitable isolated tissue preparation. (01 Experiment)
6. Effects of autonomic drugs on rabbit's eye. ( 01 Experiments)
7. Effect of physostigmine and atropine on ciliary movement in frog buccal cavity. (01 Experiments)

8. Experiments on skeletal muscle relaxant activity (01 Experiment)
9. Local anesthetic activity of drugs using suitable animal model. (02 Experiment)
10. Experiments on hypnotic and sedative activity. (01 Experiment)
11. Experiments on central analgesic activity. (01 Experiment)
12. Experiments on anti-epileptic activity. (02 Experiments)
13. Experiments on antidepressant activity. (02 Experiment)
14. Experiments on antipsychotic activity. (01 Experiment)

**Books Recommended**

1. Essentials of Medical Pharmacology by K.D. Tripathy
2. Pharmacology & Pharmacotherapeutics by Santoshkar & P Sen
3. Pharmacology by Prasun K Das, S.K. Bhattacharya and P.Sen
4. The Pharmacological basis of the Therapeutics by Goodman & Gilman
5. Pharmacology by Rang, Dale & Ritter
6. Basic and Clinical Pharmacology by B.G.Katzung

**PHARMACOGNOSY-III**

**15PH505**

**THEORY**

**3 hours/ week**

**MODULE -I**

1. General methods of isolation and preliminary phytochemical screening of glycosides.
2. Study of the biological source, cultivation, collection, chemical constituents, adulterants, uses, macroscopic, microscopic features and chemical tests of following group of drugs containing –
  - i) Saponins: Liquorice, ginseng, dioscorea, sarasparilla and senega.
  - ii) Cardioactive sterols: Digitalis, squill and strophanthus
  - iii) Anthraquinone cathartics: Aloes, senna, rhubarb and cascara.
  - iv) Others: Psoralea, gentian, saffron, chirata and quassia

**MODULE -II**

3. Biological sources, preparation, identification tests and uses of the following enzymes: Diastase, papain, pepsin, trypsin, pancreatin.
4. Basic metabolic pathways. Techniques used to study of various pathways. Biogenesis of aromatic amino acids, steroidal glycosides, tropane alkaloids and indole alkaloids.

**MODULE -III**

5. Historical development of plant tissue culture, types of cultures, nutritional requirements, growth and their maintenance. Application of plant tissue cultures with special reference to production of secondary metabolites.

**MODULE -IV**

6. An introduction to poisonous plants in India.
7. Marine pharmacognosy, novel medicinal agents from marine sources.

**MODULE-V**

8. Study of Nutraceuticals: General introduction, Classification, minerals & vitamin supplements, Digestive enzymes, Probiotics, Dietary fibres, Cereals & grain, Health drinks.

**RECOMMENDED BOOKS:**

1. Textbook of Pharmacognosy by C.K.Kokate and D.P.Purohit (Nirali Prakashan, Pune)
2. Trease G.E. and Evans w.e., Pharmacognosy (Baillere Tindall, Eastbourne)
3. Tyler V.E., Brady L.R. and Robbers J.E., Pharmacognosy (Len & Febiger, Philadelphia)
4. Pharmacognosy by T.E. Wallis(CBS Publisher, New Delhi)
5. Staba E.J., Plant Tissue Culture as a source of Bio-medicinals
6. Rangari V D., Text book of Pharmacognosy Vol-I & II.
7. Pharmacognsy & Pharmabiotechnology by Ashutosh Kar

**PHARMACEUTICAL MICROBIOLOGY**

**15PH506**

**THEORY**

**3 hours/ week**

**UNIT -I**

Scope and future of microbiology.

Classification of microbes. Morphological study of Bacteria

Brief introduction about Actinomycetes, Fungi, Rickettsiae, Spirochetes and Viruses and their importance in pharmaceuticals.

**UNIT-II**

Nutrition, cultivation and isolation of bacteria, actinomycetes, fungi and viruses.

Identification of Microbes : Cultural characteristics, Biochemical reactions, Staining techniques (simple staining, Gram staining, negative Staining) of bacteria.

Preservation of microbial cultures

**UNIT -III**

Microbial genetics – Mutations, Isolation of mutants, factors influencing rate of mutation, mutagens. Transformation, conjugation, transduction.

**UNIT -IV**

Sterilization, different methods, validation of sterilization methods & equipment.

Disinfection, factors influencing disinfectants and antiseptics and their evaluation.

Test for sterility – Importance, objectives, methodology as per pharmacopoeial standards, evaluation tests. Microbial limit tests for pharmaceutical dosage forms.

**UNIT -V**

Microbiological assay of antibiotics – penicillin, Vitamins – vitamin B12 and amino acids – lysine.

Industrial production of Ethanol and Lactic acid

**PHARMACEUTICAL MICROBIOLOGY**

**15PH506**

**PRACTICAL**

**3 hours/ week**

***(A minimum of 15 experiments shall be conducted)***

Experiments devised to prepare various types of culture media, sub-culturing of common aerobic bacteria, fungi and yeast. Various staining methods, various methods of isolation of microbes, sterilization techniques and validation of sterilizing techniques, evaluation of antiseptics and disinfectants, Testing the sterility of pharmaceutical products as per I.P. requirements and Microbiological assay of antibiotics.

1. Sterilization
2. Preparation of Culture media
3. Isolation of microbes (Bacteria and Fungus)
4. Morphological identification of microbes
5. Gram's staining Technique
6. Evaluation of disinfectants
7. Microbiological assay of antibiotics
8. Sterility testing

**RECOMMENDED BOOKS:**

1. Microbiology of Pelczar and Kreig.
2. Text Book of Microbiology by Anantanarayana and Panicker.
3. Prescott, Harley and Klein's Microbiology
4. Shah and Shah (Pharmaceutical Microbiology)
5. Microbiology by Tortora
6. Microbiology by R P Singh
7. A textbook of Microbiology by R C Dubey
8. Industrial Microbiology by L E Casida
9. Textbook of Medical microbiology by Satish Gupte

**6<sup>th</sup> SEMESTER**

**PHARMACEUTICS-III**

(Pharm. Tech-II)

**15PH601**

**THEORY**

**3 hours/week**

**UNIT -I**

**1. Parenteral Products:** Introduction to parenteral products and routes of administration. Formulation: Vehicles, additives. containers and closures. Facilities: Design of aseptic area, environmental control, traffic control, housekeeping, surface disinfection, air control, personnel. Processing: Cleaning of equipment, containers and closures, filling, sealing, sterilization, packaging and labeling. Evaluation of parenteral products

**UNIT-II**

**2. Ophthalmic Preparations:** Introduction, pharmacological categories of ophthalmic drugs, pharmaceutical requirements, packaging, administration. Contact lenses & its care and use solutions & evaluation of upcoming products.

**UNIT-III**

**3. Pharmaceutical Aerosols:** Definition, applications, components of aerosol package: Propellants, container, valve and actuator types. Formulation of pharmaceutical aerosols, manufacturing and filling methods, quality control tests.

**UNIT –IV**

**4. Micro-encapsulation:** Types of microcapsule, applications of microencapsulation in pharmacy, microencapsulation by co-acervation phase separation, multi orifice, spray drying, spray congealing, polymerization complex emulsion, air suspension technique, solvent evaporation and pan coating, evaluation of microcapsules.

**UNIT -V**

**5. Packaging of Pharmaceutical Products:** Packaging components: glass, plastic, metal, fibrous material, specifications and methods of evaluation of packaging component, Closure and Closure liners, Tamper Resistant Packaging, Regulatory and quality consideration.

**PHARMACEUTICS – III**

**(Pharmaceutical Technology II)**

**PRACTICAL**

1. Preparation of SVP and LVP.
2. Evaluation of parenterals such as sterility test, pyrogen test (Rabbit and LAL test), clarity test, leakage test etc.
3. Filling and sealing of ampoules under aseptic condition.
4. Preparation and evaluation of ophthalmic solution, suspension, emulsion and ointment etc.
5. Preparation and evaluation of aerosols.
6. Preparation and evaluation of microcapsules by different methods such as ionic gelation, solvent evaporation, coacervation phase separation method etc.
7. Evaluation of glass containers.
8. Water vapor permeation studies.

**RECOMMENDED BOOKS :**

1. Bently's Textbook of pharmaceuticals edited by E.A. Rawlins
2. The Theory and Practice of Industrial Pharmacy by Lachmann, Libermann and Kanig

**MEDICINAL CHEMISTRY-II**

**15PH602**

**THEORY**

**3 hours/week**

Classification, mode of action, uses and structure activity relationship of the following classes of drugs. Synthesis of those compounds only exemplified against each class.

**UNIT -I**

**Drugs acting on the Central Nervous System:**

- **General Anaesthetics** : Anesthetic ether, Halothane, Thiopental sodium.
- **Local Anaesthetics** : Benzocaine, Procaine, Lignocaine,
- **Hypnotics and Sedatives**: Phenobarbitone, Cyclobarbitone, , Diazepam
- **Opioid analgesics** : Pethidine, Methadone.

**UNIT -II**

- **Anticonvulsants** : Phenytoin, Ethosuximide, Primidone,
- **Antiparkinsonism drugs**: Levodopa, Amantidine
- **CNS stimulants** : Nikethemide, Ethamivan, Amphetamine
- **Psychopharmacological agents** (neuroleptics, antidepressants, anxiolytics): Chlorpromazine, Haloperidol, Imipramine, Phenelzine, Chlordiazepoxide, Alprazolam.

**UNIT -III**

**Antibiotics**: General study including classification, synthesis of Methicillin, Ampicillin, Amoxycillin and Chloramphenicol

**Anti-viral including anti-HIV agents**: Acyclovir, Zidovudine

**Immunosuppressives and immunostimulants**: To study only the general concept

**Anti Malarial Drugs**: Chloroquine, Pamquine, Mepacrine, Proguanil, Pyrimethamine.

**Antineoplastic agents**: Chlorambucil, Thiotepa, Busulfan, 5-Fluorouracil

**UNIT -IV**

**Thyroid and Anti thyroid drugs**: Thyroxine, Liothyronine, Propylthiouracil, Carbimazole

**Insulin, Insulin preparations and oral hypoglycaemic agents**: Chlorpropamide, Tolbutamide, Glibenclamide, Phenformin.

**UNIT –V**

**Enzyme Inhibitors**: A detailed study of the following types of enzyme inhibitors, related drugs and their pharmaceutical significance;

- Phosphodiesterase (PDE) inhibitors.
- Angiotensin converting enzyme (ACE) Inhibitors

**Medicinal Chemistry – II**

**PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Synthesis of selected drugs from the course content
2. Monographs of selected official drugs including identification tests and tests for purity.

**RECOMMENDED BOOKS:**

1. Wilson and Grisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry
2. Principles of Medicinal Chemistry by William O.Foye
3. A Text Book of Medicinal Chemistry by S.N.Pandeya
4. Medicinal Chemistry by Ashutoshkar
5. Bentley's and Driver's Text Book of Pharmaceutical Chemistry.



## **PHARMACOLOGY-II**

15PH603

THEORY

3 hours/week

### **UNIT-I**

#### **1. Pharmacology of drugs acting on cardiovascular system:**

- 1.1. Cardiac glycosides and drug for heart failure.
- 1.2. Antihypertensive drug.
- 1.3. Antianginal and vasodilator drug.
- 1.4. Antiarrhythmic drug.

### **UNIT-II**

#### **2. Pharmacology of drugs acting on haemopoetic system:**

- 2.1. Haematinics.
- 2.2. Coagulants, anticoagulants, fibrinolytics and antiplatelet drug.
- 2.3. Hypolipidemic drugs.

### **UNIT-III**

#### **3. Autacoids:**

- 3.1. Amine autacoids: Histamine and their antagonist (special reference to H1 receptor antagonist), Serotonin and serotonin antagonist.
- 3.2. Lipid derived autacoids: Prostaglandin and other eicosanoids (Thromboxane, leukotrine).
- 3.3. Peptide autacoids: Angiotensin, bradykinin.
- 3.4. Non-steroidal anti-inflammatory drugs.

### **UNIT-IV**

#### **4. Drugs acting on respiratory system:**

- 4.1. Anti-tussive and expectorant.
- 4.2. Anti-asthmatic drugs.
- 4.3. Respiratory stimulant.

### **UNIT-V**

#### **5. Drug acting on urinary system:**

- 5.1. Diuretics.
- 5.2. Antidiuretics.

## **PHARMACOLOGY-II**

### **PRACTICAL**

1. Effects of electrolytes on isolated frog's heart. (01 Experiment)
2. Experiments on inotropic and chronotropic effect of drug in isolated frog heart. (01 Experiment)
3. To study the effect of cardiac glycoside on normal and hypodynamic heart of frog. (01 Experiment)
4. To record the DRC of Ach, histamine and serotonin using suitable isolated tissue preparation. (03 Experiment)
5. Bioassay of Ach/histamine/5-HT by matching method using suitable isolated tissue. (01 Experiment)
6. Bioassay of Ach/histamine/5-HT by bracketing method using suitable isolated tissue. (01 Experiment)
7. Bioassay of Ach/histamine/5-HT by interpolation method using suitable isolated tissue. (01 Experiment)

**PHARMACOGNOSY-IV**

**15PH604**

**THEORY**

**3 hours/week**

**UNIT-I**

1. General methods of extraction, isolation and chemical tests of Alkaloids.
2. Systematic study of source, cultivation, collection, chemical constituents, adulterants, uses, macroscopic, microscopic features and chemical tests of the following alkaloids containing drugs.
  - Pyridine- Piperidine Tobacco, Arica, Lobelia
  - Tropane- Belladonna, Hyoscyamus, Daturas, Withania.
  - Quinoline and Isoquinoline- Cinchona, Ipecac, Opium
  - Indole- Ergot, Rauwolfia, Catharanthus, Nux-vomica, Physostigma
  - Imidazole- Pilocarpus
  - Steroidal- Veratrum and Kurchi
  - Alkaloid amines- Ephedra, Colchicum
  - Glycoalkaloid- Solanum
  - Xanthine alkaloid- Coffee, Coca.

**UNIT-II**

3. Study of traditional drugs, common vernacular names, botanical source, chemical constituents, uses and marketed formulations (any two) of the following drugs :
4. Amla, Satavari, Bhilwua, Bael, Bach, Rasna, Punarnava, Gokhru, Shankhapushpi, Brahmi, Aduśa, Arjuna, Lahsun, Guggul, Gymnema, Neem, Tulsi, Shilajit and Spirulina.

**UNIT-III**

5. Holistic concept in traditional system of medicine. Introduction of ayurvedic preparation like Asvas, Aristas, Guticas, Tailas, Lehyas and Bhasmas.

**UNIT-IV**

6. Utilization and production of phytoconstituents such as Quinine, Calcium sennosides, Podophyllotoxin, Diosgenin and Tropane alkaloids.

**UNIT-V**

7. Separation of phytoconstituents by using Chromatographic techniques.
  - i. Paper chromatography, ii. Column chromatography, iii. Thin layer chromatography

**PHARMACOGNOSY-IV**

**PRACTICAL**

**3 hours/week**

**(A minimum of 15 experiments shall be conducted)**

1. Identifications of crude drugs listed in theory. (any five)
2. Microscopic study of characters of six – selected drugs given in theory in entire and powder form.
3. Specific chemical tests of some alkaloidal crude drugs listed in theory.
4. Standardization of some traditional drug formulations.
5. TLC & Paper chromatography characterisation of medicinal plant extracts.

**RECOMMENDED BOOKS:**

1. Trease G.E. and Evans W E., Pharmacognosy.
2. Pharmacognosy by T.E. Wallis.
3. Pharmacognosy by C.K. Kokate.
4. Kalia A N., Text book of Industrial Pharmacognosy.
5. Rangari V D., Text book of Pharmacognosy Vol-I & II.
6. Atal C K., Cultivation and utilization of medicinal and aromatic plants of India.
7. Peach and Tracey M.V., Modern method of plant analysis.

**PHARMACEUTICAL BIOTECHNOLOGY**

**15PH605**

**THEORY**

**3 hours/week**

**UNIT -I**

1. Brief introduction to Biotechnology with reference to Pharmaceutical sciences.
2. **Immunology and Immunological Preparations:** Principles of immunology and immunological products, antigens, antibodies, Immune system- cellular and humoral immunity, immunological tolerance, Hypersensitivity, Active and passive immunization.

**UNIT –II**

3. **Genetic Code and Protein Synthesis:** Genetic code, components of protein synthesis, inhibition of protein synthesis. Brief account of protein engineering and Polymerase Chain Reactions.
4. **Genetic Recombination:** Gene cloning and its applications. Hybridoma Technology- Production, Purification and Applications.

**UNIT -III**

5. **Microbial Transformation:** Introduction to Microbial biotransformation and applications.
6. Immuno blotting techniques- ELISA, Western blotting, Southern blotting. Mutation.

**UNIT -IV**

7. Fermenter, its design, control of different parameters. Design of fermentation process,
8. Isolation of fermentation products with special reference to Penicillin, Citric acid and Vitamin B12.

**UNIT -V**

9. **Enzyme Biotechnology:** Methods of Enzyme Immobilization and applications.
10. **Biosensors:** Working and application in pharmaceutical industry.
11. Study of enzymes such as Pencillinase, Streptokinase and Amylases and Proteases etc.

**RECOMMENDED BOOKS :**

1. Industrial Microbiology by Casida.
2. Industrial Microbiology by A.H. Patel.
3. Industrial microbiology by Prescott and Dunn.
4. Pharmaceutical Biotechnology by Vyas and Dixit.
5. Molecularbiology and Genetic Engineering by A.M.Narayanan, A.M.Selvaraj, A.Mani
6. Text Book of Microbiology by Anantanarayana and Panicker.
7. Concepts in Biotechnology by Balasubramaniam.
8. Molecular Biotechnology by B R Glick.
9. Molecular Biotechnology by Gingold

**PHARMACEUTICAL JURISPRUDENCE & ETHICS**

15PH606

THEORY

2 hours/week

**UNIT -1**

**1. Origin and Nature of Pharmaceutical Legislations in India:** A brief review, Religion, Ethics, Law, Study of drugs enquiry committee, Health survey and development committee.

**2. Pharmacy Act, 1948:** Introduction, Objectives, Pharmacy Council of India- Constitution and Functions, Education Regulations, State and Joint State Pharmacy Council- Constitution and Functions, Registration of Pharmacists, Offences and Penalties.

**UNIT -II**

**3. Code of Pharmaceutical Ethics:** Introduction, General introduction to code of pharmaceutical ethics, Pharmacist in relation to his Job, Pharmacist in relation to his Trade, Pharmacist in relation to Medical profession and Pharmacist in relation to his Profession.

**4. Drugs Price Control Order (DPCO), 1995:** Introduction, Prices of Bulk drugs, Retail prices of formulations.

**UNIT -III**

**5. Drugs and Cosmetics Act 1940 and Rules 1945:** Introduction, Legal definitions of Schedules to the Act and Rules; Import of Drugs, Manufacture of Drugs, Sale of Drugs, Administration of the Act- Drugs Technical Advisory Board, Drugs Consultative Committee, Central drugs Laboratory, Government Analysts, Licensing authorities, Drugs Inspectors.

**6. Drugs and Magic Remedies (Objectionable Advertisements) Act, 1954:**

Introduction, Definitions, Prohibited advertisements, Classes of Exempted advertisements, Prohibition on Import and Export of Advertisements, Offences and Penalties.

**UNIT -IV**

**7. Medical Termination of Pregnancy Act 1971 & Rules 1975:** Introduction, Provisions for termination of pregnancy, Offences and Penalties.

**8. Narcotic Drugs and Psychotropic Substances Act, 1985 and Rules:** Introduction, Definitions, Administrative Agencies, Offences and Penalties.

**UNIT-V**

**9. Medicinal and Toilet Preparations (Excise Duties) Act, 1955:** Introduction, Manufacture In Bond and Outside bond, Export of alcoholic preparations, Offences and Penalties.

**10. Prevention of Cruelty to Animals Act, 1960:** Introduction, Experimentation on Animals, CPCSEA Guidelines, Offences and Penalties.

**RECOMMENDED BOOKS:**

1. A Textbook of Forensic Pharmacy by B.M.Mithal
2. A Textbook of Forensic Pharmacy by N.K.Jain
3. Drugs and Cosmetics Act and Rules published by Government of India
4. Pharmacy Act, Published by Government of India
5. Law of Drugs
6. Drug Cases published by International Law Book Co. Delhi (Reference)
7. A text book of Forensic Pharmacy by G. Vidya Sagar, T.V. Narayan

**7<sup>th</sup> Semester**

**BIOPHARMACEUTICS & PHARMACOKINETICS**

**15PH701      THEORY**

**3 hours / week**

**UNIT -I**

Introduction to Biopharmaceutics and Pharmacokinetics and their role in information development and clinical setting.

Biopharmaceutics : Passage of drugs across biological barrier (passive diffusion, active transport facilitated Diffusion and pinocytosis.

Factors influencing absorption-Physicochemical, physiological and pharmaceutical.

**UNIT -II**

**Distribution of drugs:** Factors affecting distribution of drugs, Physiologic barriers to distribution of drugs, volume of distribution.

**Protein Binding of drugs:** plasma and tissue protein binding of drugs, factors affecting protein drug binding, Kinetics of protein drug binding.

**Biotransformation of drugs:** Introduction, chemical pathways of drug biotransformation, Factors affecting biotransformation of drugs.

**UNIT -III**

**Excretion of Drugs:** Renal excretion of drugs, concept of clearance, factors affecting renal clearance, and non-renal routes of drug excretion.

**Pharmacokinetics: Basic consideration**

Significance of plasma drug concentration time profile

Rate, rate constants and orders of reaction

Pharmacokinetic models: Compartment models, Non compartmental analysis, Physiologic model

**UNIT-IV**

**One compartment open model**

Determination of pharmacokinetic parameters from blood and urine data

I.V bolus, IV infusion and extra-vascular administration.

Introduction to two compartment model.

**UNIT -V**

**Bioavailability and bioequivalence:** Consideration in bioavailability study design, Measurement of bioavailability by pharmacokinetic and pharmacodynamic methods, bioequivalence study design protocol, IVIVC.

**RECOMMENDED BOOKS:**

1. Biopharmaceutics and Pharmacokinetics by D.M. Brahmkar and Sunil B. Jaiswal
2. Fundamentals of Biopharmaceutics and Pharmacokinetics by V. Venkateswarulu
3. Biopharmaceutics and Clinical Pharmacokinetics by Notari
4. Biopharmaceutics and Clinical Pharmacokinetics by Gibaldi
5. Applied Biopharmaceutics and Pharmacokinetics by Shargel and Yu

**BIOPHARMACEUTICS & PHARMACOKINETICS PRACTICAL 3 Hrs/Week**  
**(A minimum of 15 experiments shall be conducted)**

1. *In vitro* dissolution testing of tablets, capsules, suspensions etc.
2. Kinetic study of dissolution of drug.
3. Effect of pH, rpm on dissolution of drugs.
4. *In vitro* bioequivalence testing on marketed tablets.
5. *In vitro* permeation study using Franz diffusion cell.
6. Intestinal permeability using chicken or rat intestine.
7. Protein-binding of drugs by different methods.
8. To study the influence of urinary pH on excretion of drugs.
9. Calculation of area under curve by trapezoidal rule.
10. Calculation of pharmacokinetic parameters from plasma and urine data with special reference to IV bolus, IV infusion and EV administration.

**PHYTOCHEMISTRY****THEORY****3 hours/ week****15PH702****UNIT -I**

Chemical and spectral approaches to simple molecules of natural origin. Application of I.R., N.M.R. and Mass spectroscopy in the structural elucidation of organic compounds.

Concept of stereoisomerism taking examples of natural products (citral, menthol, camphor, ephedrine and atropine).

**UNIT -II**

**Cardiac Glycosides:** Source, structures, Pharmacological properties and study of interrelationship between cardenolides and bufadienolides (Chemistry of digoxin & digitoxin ). Introduction to Scillaren A and ouabain.

**Terpenes :** Classification, General methods of extraction and separation ( Mono and sesquiterpenes), special isoprene rule and Structural elucidation of citral carvone, menthol & camphor

**UNIT -III**

**Vitamins :** Classification, Chemistry & uses of vitamin A, B<sub>1</sub>, Folic acid and vitamin C.

**UNIT -IV**

**Alkaloids :** Classification, isolation, structural elucidation & uses of atropine, ephedrine, reserpine and morphine.

**UNIT -V**

Chemistry and therapeutic activity of penicillin (includes structural elucidation), streptomycin and tetracyclines.

**Flavonoids:** Classification, pharmacological properties and chemistry of quercetin .

**PHYTOCHEMISTRY PRACTICAL****3 hours/ week****(A minimum of 15 experiments shall be conducted)**

1. Analysis of fixed oils including acid value, saponification value, iodine value.
2. Determination of hydroxyl compounds (phenolic and alcoholic).
3. Isolation of active principles from natural sources (at least four).
4. Determination of aldehydes and ketones in essential oils.
5. Exercises on paper and thin layer chromatographic evaluations of herbal drug constituents.

**RECOMMENDED BOOKS :**

1. Chemistry of Organic Natural Products (Vol.-1 & 2) by O.P. Agarwal.
2. Organic Chemistry of Natural Products (Vol.-1 & 2) by Gurdeep Chatwal.
3. Organic Chemistry (Vol.-2) by I.L. Finar.

**PHARMACEUTICAL ANALYSIS-III**

**15PH703**

**THEORY**

**3 hours/ week**

**UNIT -I**

- 1. Ultraviolet and visible spectrophotometry-** Introduction, Basic Principle, Instrumentation, Practical Applications, Interpretation of spectra.
- 2. Atomic Absorption Spectroscopy-** Principle, Instrumentation and Applications.
- 3. Flame Photometry-** Principle, Instrumentation and Applications.

**UNIT -II**

- 1. Infrared spectrophotometry-** Basic Principle, Instrumentation, Practical Applications, Interpretation of spectra. Fundamentals of Ft-IR.
- 2. Nuclear Magnetic resonance spectroscopy ( $H^1$  NMR,  $C^{13}$  NMR)** - Theoretical aspects, Instrumentation and Applications.
- 3. Mass Spectrometry-** Basic Principle, Instrumentation, Practical Applications, Interpretation of spectra.

**UNIT -III**

Introduction to Chromatography, Types of Chromatography, Various Modes.

- 1. Column Chromatography-** Principle, Instrumentation and Applications.
- 2. Liquid Chromatography-** Principle, Instrumentation and Applications.

**UNIT-IV**

- 1. Thin Layer Chromatography (TLC)** - Principle, Instrumentation and Applications.
- 2. High Performance Thin Layer Chromatography (HPTLC)** – Basic Principle and Practical Applications.

**UNIT-V**

- 1. High Performance Liquid Chromatography-** Principle, Instrumentation and Applications.
- 2. Gas Chromatography-** Theoretical considerations, Instrumentation and Applications.

**PHARMACEUTICAL ANALYSIS-III**

**PRACTICAL**

**3 hours/ week**

**(A minimum of 15 experiments shall be conducted)**

- Quantitative estimation of at least ten formulations containing single or more than one drug, using instrumental techniques like spectrophotometry, flame photometry, etc.
- Chromatographic analysis of some pharmaceutical products, (Column chromatography of crude drugs, TLC of alkaloids, sulphonamides etc)
- Workshop to interpret the structure of simple organic compounds using UV, IR, NMR and MS.

**RECOMMENDED BOOKS:**

1. Vogel's Text Book of Quantitative Chemical Analysis
2. Instrumental methods of Chemical Analysis by B.K. Sharma
3. Instrumental methods of Analysis by Willard Den & Merrit
4. Practical Pharmaceutical Chemistry by Beckett and Sten Lake Vol. 2
5. Text Book of Pharmaceutical Analysis by K.A.Conner.
6. Instrumental methods of Chemical Analysis by G.R.Chatwal.



**PHARMACOLOGY-III**

**15PH704**

**THEORY**

**3 hours/ week**

**UNIT-I**

**1. Pharmacology of drugs acting on Gastrointestinal tract:**

- 1.1. Antacids, Anti-secretory and Anti-ulcer drugs.
- 1.2. Laxatives and antidiarrhoeal drugs.
- 1.3. Emetics and Anti-emetics.
- 1.4. Appetite stimulant and suppressant.

**UNIT-II**

**2. Pharmacology of drugs acting on Endocrine system:**

- 2.1. Hypothalamic and pituitary hormones.
- 2.2. Thyroid hormones and anti-thyroid drugs.
- 2.3. Parathormone, calcitonin and Vitamin-D.
- 2.4. ACTH and corticosteroids.
- 2.5. Androgen and anabolic steroids.
- 2.6. Estrogen, progesterone and oral contraceptive.
- 2.7. Insulin, glucagon and oral hypoglycemic agents.

**UNIT-III**

**3. Antimicrobial drugs-I:**

- 3.1. General principle of chemotherapy
- 3.2. Sulfonamides, cotrimoxazole, quinolones.
- 3.3. Penicillin, cephalosporin.
- 3.4. Tetracycline, chloramphenicol.
- 3.5. Aminoglycoside antibiotic.
- 3.6. Macrolides.

**UNIT-IV**

**4. Antimicrobial drugs-II:**

- 4.1. Anti-tubercular and Anti-leprotic drugs.
- 4.2. Anti-malarial drugs.
- 4.3. Anti-viral and Anti-retroviral drugs.
- 4.4. Anti-fungal drugs.
- 4.5. Anti-helminthics drugs.

**UNIT-V**

**5. Miscellaneous:**

- 5.1. Anti-neoplastic and immunosuppressive drugs.
- 5.2. Introduction to preclinical and clinical evaluation of new drugs, pharmacovigilance

**Books Recommended**

7. Essentials of Medical Pharmacology by K.D. Tripathy
8. Pharmacology & Pharmacotherapeutics by Santoshkar & P Sen
9. Pharmacology by Prasun K Das, S.K. Bhattacharya and P.Sen
10. The Pharmacological basis of the Therapeutics by Goodman & Gilman
11. Pharmacology by Rang, Dale & Ritter
12. Basic and Clinical Pharmacology by B.G.Katzung

**RESEARCH METHODOLOGY**

**15PH705**

**THEORY**

**3 hours/ week**

**Unit - I**

**Introduction to Research:** Definitions, characteristics and significance of research; Types of research; Needs for Research; Needs for design of experiment.

**Research Process:** Objectives of Research process; Research design: Exploratory, Descriptive, Experimental and Observational.

**Unit - II**

**Sampling:** Sampling fundamentals, Sample design, Methods of drawing samples, Lottery method and using random number table. Concept of different sampling methods.

**Work Plan:** Summary of the major components of a research proposal; Fieldwork, Formation of Hypothesis: Null hypothesis, Alternative hypothesis.

**Unit – III**

**Measurement:** Design of Questionnaire; Identification of Research problem, Measurement of problem and scaling techniques.

**Data Collection:** Various sources of data collection, Primary data, Secondary data, data processing.

**Unit - IV**

**Probability:** Definition of probability, Sampling distribution , Binomial distribution, Normal distribution, Poisson's distribution.

**Data analysis and Statistics:** Hypothesis testing, Type I and Type II error, standard error, Factor Analysis (concept only); Correlation & regression analysis. ANOVA, t-test, z-test, Chi-square test of (i) Variance of a normal population (ii) Goodness of fit. Non-parametric tests, sign test, run test.

**Unit – V**

**Report writing and Presentation:** Types and Structure of research report, ethical issues in research, presentation of report.

**Computer Applications:** Data storing, features for statistical data analysis, generating charts/graphs & other features. [Tools: Microsoft Excel, Open office and similar or other advanced tools], Thesis writing & Scientific editing tools.

**References:**

1. Montgomery, Douglas C. (2007) 5/e, Design and Analysis of Experiments (Wiley India)
2. Montgomery, Douglas C. & Runger, George C. (2007) 3/e, Applied Statistics & probability for Engineers (Wiley India)
3. Kothari C.K. (2004) 2/e, Research Methodology – Methods and Techniques (New Age International, New Delhi)
4. Krishnswamy, K.N., Shivkumar, Appa Iyer and Mathiranjani M. (2006) Management Research Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
5. The Complete reference Office Xp- Stephan L. Nelson, Gujulia Kelly (TMH)
6. Biostatistics by Alvin E. Lewis.
7. Introduction to probability & Statistics by Henry L. Alder & Edward B. Roessler.
8. Basic Computer Science and Communication Engineering – R. Rajaram (SCITECH)

**15PH706: Professional Elective-I**

**DRUG REGULATORY AFFAIRS & INTELLECTUAL PROPERTY RIGHTS**

**15PH706.E.1.**

**THEORY**

**3 Hrs/Week**

**MODULE-I**

1. Documentation in Pharmaceutical industry: MFR (Master Formula Record), DMF (Drug Master File), BPR (Batch Processing Record), Packaging and Distribution records, BRR (Batch Release Record).
2. Generic drugs product development: Introduction to generic & brand name of drugs, drug development process.

**MODULE-II**

1. Total Quality Management (TQM) - Introduction, Basic Principles, Benefits.
2. ISO 9000, 9001 and 9002 documentation: Introduction: Guidance on the terminology used in ISO 9000:2000, ISO 9001:2000.

**MODULE-III**

1. Introduction to Intellectual Property Rights (IPR) & basic terminology of Copyright, Trademark and Patents.
2. Regulatory requirement for product approval: API, novel therapies obtaining IND, NDA, ANDA process.

**MODULE-IV**

1. Clinical trials: Developing clinical trial protocols. Requirement to clinical study process, Introduction to pharmacovigilance.

**MODULE-V**

1. Stability Studies: ICH guidelines and WHO guidelines and stability testing protocols for dosage forms.

**REFERENCES**

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143.
2. New Drug Approval Process: Accelerating Global Registrations by Richard a Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
3. ISO 9000 and Total Quality Management by S.K.Ghosh.
4. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance by Fay A. Rozovsky and Rodney K. Adams.
5. How to Practice GMP by P.P.Sharma.
6. GMPs by Mehra.
7. Validation of analytical procedure: methodology, **ICH harmonized tripartite guideline**, (1996).

**COSMETIC TECHNOLOGY**

**15PH706.E.2**

**THEORY**

**3 hours/week**

**UNIT –I**

1. Fundamentals of cosmetic technology, classification of cosmetics, A brief study of raw materials used for Cosmetic preparations: surfactants, humectants, cream bases, aerosol propellants, perfumes, colours.

**UNIT -II**

2. Hair Care Products: Hair structure, Shampoos, Conditioners, Setting lotion, Hair creams, Hair dyes.
3. Skin Care Products: Anatomy and physiology of skin, formulation of skin cleaners, moisturizers, sunscreen products, acne products, anti ageing creams.

**UNIT -III**

4. Colour Cosmetics: Introduction, lip colour, nail polish, face make-up eye make-up.
5. Dental products: Dentifrices, Oral rinses, Tooth powder, Tooth paste.
6. Personal Hygiene Products: Shaving creams, after shave products.

**UNIT -IV**

7. Herbal Cosmetics: Introduction, use of plant materials in formulation of cosmetics with emphasis on dentifrices, skin care products and personal hygiene products.
8. **Safety testing of Cosmetic Products** : Microbiology in Cosmetics, Knowledge of the various microbial contaminants in cosmetic products, Knowledge of various preservative systems for cosmetic products, Selection criteria for preservatives, Efficacy and safety testing of preservatives in cosmetic products.

**UNIT-V**

9. Stability aspects of cosmetics: Shelf-life, effects of environmental factors like light, temperatures etc on product stability.
10. Quality control tests of different cosmetic products, Packaging of Cosmetics

**RECOMMENDED BOOKS:**

1. Cosmetics: Formulation, manufacturing, and Quality control by P.P.Sharma
2. A Handbook of Cosmetics by B.M. Mithal, R.N. Saha
3. The Theory and Practice of Industrial Pharmacy by Lachman L., Liberman, H.A.
4. Modern Cosmetics by Thomson, E.G.
5. Paucher's Perfumes, cosmetics & soaps by W.A.Paucher.
6. Hary's cosmeticology by J.B.Wilkimsson.