DEVI AHILYA VISHWAVIDYALAYA, INDORE

School of Pharmacy

1.1.1
Syllabus of all programs

DEVI AHILYA VISHWAVIDYALAYA, INDORE

SCHOOL OF PHARMACY

B.PHARM.

SYLLABUS

(Prescribed by Pharmacy Council of India)

w.e.f academic session 2016-17

B. PHARM. FIRST SEMESTER

Table-I: Course of study for semester I

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP101T	Human Anatomy and Physiology I– Theory	3	1	4
BP102T	Pharmaceutical Analysis I – Theory	3	1	4
BP103T	Pharmaceutics I – Theory	3	1	4
BP104T	Pharmaceutical Inorganic Chemistry – Theory	3	1	4
BP105T	Communication skills – Theory *	2	-	2
BP106RBT BP106RMT	Remedial Biology/ Remedial Mathematics – Theory*	2	-	2
BP107P	Human Anatomy and Physiology – Practical	4	-	2
BP108P	Pharmaceutical Analysis I – Practical	4	-	2
BP109P	Pharmaceutics I – Practical	4	-	2
BP110P	Pharmaceutical Inorganic Chemistry – Practical	4	-	2
BP111P	Communication skills – Practical*	2	-	1
BP112RBP	Remedial Biology – Practical*	2	-	1
		32/34$/36#	**4**	**27/29$/30#**

Table-II: Scheme for Internal Assessments and end semester examinations

SEMESTER I

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP101T	Human Anatomy and Physiology I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP102T	Pharmaceutical Analysis I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP103T	Pharmaceutics I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP104T	Pharmaceutical Inorganic Chemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP105 T	Communication skills – Theory *	5	10	1 Hr	15	35	1.5 Hrs	50
BP106 RBT BP106 RMT	Remedial Biology/ Remedial Mathematics – Theory*	5	10	1 Hr	15	35	1.5 Hrs	50
BP107P	Human Anatomy and Physiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP108P	Pharmaceutical Analysis I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP109P	Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP110P	Pharmaceutical Inorganic Chemistry – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP 111P	Communication skills – Practical*	5	5	2 Hr	10	15	2 Hrs	25
BP 112 RBP	Remedial Biology – Practical*	5	5	2 Hr	10	15	2 Hrs	25
		70/75 $/80#	**115/125$/130#**	**23/24$/26# Hrs**	**185/200$/210**	**490/525$/540#**	**31.5/33$/35# Hrs**	**675/725$/750#**

#Applicable ONLY for the students studied Mathematics / Physics / Chemistry at HSC and appearing for Remedial Biology (RB) course.

$Applicable ONLY for the students studied Physics / Chemistry / Botany / Zoology at HSC and appearing for Remedial Mathematics (RM) course.

*Non University Examination (NUE)

BP101T. HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)
(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP101T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP101T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the various experiments related to special senses and nervous system.
5. Appreciate coordinated working pattern of different organs of each system

Course Content

Unit I (10 hours)

Introduction to human body: Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

Cellular level of organization: Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

Tissue level of organization: Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

Unit II (10 hours)

Integumentary system: Structure and functions of skin

Skeletal system: Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction

Joints : Structural and functional classification, types of joints movements and its articulation

Unit III (10 hours)

Body fluids and blood : Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.

Lymphatic system: Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

Unit IV (08 hours)

Peripheral nervous system: Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves.

Special senses: Structure and functions of eye, ear, nose and tongue and their disorders.

Unit V (07 hours)

Cardiovascular system : Heart-anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

BP107P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

(4 Hours/week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP107P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP107P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue
3. Microscopic study of muscular and nervous tissue
4. Identification of axial bones
5. Identification of appendicular bones
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.

2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York

3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA

4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH,U.S.A.

5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A. 31

6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.

7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.

8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books (Latest Editions)

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA

2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.

3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje ,Academic Publishers Kolkata

BP102T. PHARMACEUTICAL ANALYSIS (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP102T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP102T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Objectives: Upon completion of the course student shall be able to

1. understand the principles of volumetric and electro chemical analysis
2. carryout various volumetric and electrochemical titrations
3. develop analytical skills

Course Content:

UNIT I (10 Hours)

(a) Pharmaceutical analysis- Definition and scope

i) Different techniques of analysis

ii) Methods of expressing concentration

iii) Primary and secondary standards.

iv) Preparation and standardization of various molar and normal solutions- Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate

(b)Errors**:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures

(c)Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.

UNITII (10 Hours)

Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

UNIT-III (10 Hours)

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.

Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.

Basic Principles,methods and application of diazotisation titration.

UNIT-IV (08 Hours)

Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

UNIT-V (07 Hours)

Electrochemical methods of analysis

Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.

Potentiometry - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.

Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

BP108P. PHARMACEUTICAL ANALYSIS (Practical)

(4 Hours / Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP108P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP108P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I **Limit Test of the following**

(1) Chloride

(2) Sulphate

(3) Iron

(4) Arsenic

II **Preparation and standardization of**

(1) Sodium hydroxide

(2) Sulphuric acid

(3) Sodium thiosulfate

(4) Potassium permanganate

(5) Ceric ammonium sulphate

III **Assay of the following compounds along with Standardization of Titrant**

(1) Ammonium chloride by acid base titration

(2) Ferrous sulphate by Cerimetry

(3) Copper sulphate by Iodometry

(4) Calcium gluconate by complexometry

(5) Hydrogen peroxide by Permanganometry

(6) Sodium benzoate by non-aqueous titration

(7) Sodium Chloride by precipitation titration

IV **Determination of Normality by electro-analytical methods**

(1) Conductometric titration of strong acid against strong base

(2) Conductometric titration of strong acid and weak acid against strong base

(3) Potentiometric titration of strong acid against strong base

Recommended Books: (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London

2. A.I. Vogel, Text Book of Quantitative Inorganic analysis

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry

4. Bentley and Driver's Textbook of Pharmaceutical Chemistry

5. John H. Kennedy, Analytical chemistry principles

6. Indian Pharmacopoeia.

BP103T. PHARMACEUTICS- I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP103T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP103T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.

Objectives: Upon completion of this course the student should be able to:

1. Know the history of profession of pharmacy
2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. Understand the professional way of handling the prescription
4. Preparation of various conventional dosage forms

Course Content

UNIT-I (10 Hours)

Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.

Dosage forms: Introduction to dosage forms, classification and definitions

Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.

Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.

UNIT-II (10 Hours)

Pharmaceutical calculations: Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

Powders: Definition, classification, advantages and disadvantages,Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.

Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

UNIT-III (08 Hours)

Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.

Biphasic liquids:

Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.

Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

UNIT-IV (08 Hours)

Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.

Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

UNIV-V (07 Hours)

Semisolid dosage forms: Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms.

BP109P. PHARMACEUTICS I (Practical)

(4 Hours / week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP109P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP109P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1 . Syrups

a) Syrup IP'66

b) Compound syrup of Ferrous Phosphate BPC'68

2. Elixirs a) Piperazine citrate elixir

b) Paracetamol pediatric elixir

3.Linctus a) Terpin Hydrate Linctus IP'66

b) Iodine Throat Paint (Mandles Paint)

4. Solutions

a) Strong solution of ammonium acetate

b) Cresol with soap solution

c) Lugol's solution

5. Suspensions

a) Calamine lotion

b) Magnesium Hydroxide mixture

c) Aluminimum Hydroxide gel

6. Emulsions

a) Turpentine Liniment

b) Liquid paraffin emulsion

7. Powders and Granules

a) ORS powder (WHO)

b) Effervescent granules

c) Dusting powder

d)Divided powders

8. Suppositories

a) Glycero gelatine suppository

b) Coca butter suppository

c) Zinc Oxide suppository

8. Semisolids

a) Sulphur ointment

b) Non staining-iodine ointment with methyl salicylate

c) Carbopal gel

9. Gargles and Mouthwashes

a) Iodine gargle

b) Chlorhexidine mouthwash

Recommended Books: (Latest Editions)

1. H.C. Ansel et al., Pharmaceutical Dosage Form and Drug Delivery System, Lippincott Williams andWalkins, New Delhi.

2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, CBS publishers, New Delhi.

3. M.E. Aulton, Pharmaceutics, The Science& Dosage Form Design, Churchill Livingstone, Edinburgh.

4. Indian pharmacopoeia.

5. British pharmacopoeia.

6. Lachmann. Theory and Practice of Industrial Pharmacy,Lea& Febiger Publisher, The University of Michigan.

7. Alfonso R. Gennaro Remington. The Science and Practice of Pharmacy, Lippincott Williams, New Delhi.

8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, CBS Publications, New Delhi.

9. E.A. Rawlins, Bentley's Text Book of Pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.

10. Isaac Ghebre Sellassie: Pharmaceutical Pelletization Technology, Marcel Dekker, INC, New York.

11. Dilip M. Parikh: Handbook of Pharmaceutical Granulation Technology, Marcel Dekker, INC, New York.

12. Francoise Nieloud and Gilberte Marti-Mestres: Pharmaceutical Emulsions and Suspensions, Marcel Dekker, INC, New York.

BP104T. PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP104T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP104T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.

Objectives: Upon completion of course student shall be able to

1. know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
2. understand the medicinal and pharmaceutical importance of inorganic compounds

Course Content

UNIT I (10 Hours)

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

General methods of preparation, assay for the compounds superscripted with **asterisk (*),** properties and medicinal uses of inorganic compounds belonging to the following classes

UNIT II (10 Hours)

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

Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

UNIT III (10 Hours)

Gastrointestinal agents

Acidifiers: Ammonium chloride* and Dil. HCl

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

UNIT IV (08 Hours)

Miscellaneous compounds

Expectorants: Potassium iodide, Ammonium chloride*.

Emetics: Copper sulphate*, Sodium potassium tartarate

Haematinics: Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite

Astringents: Zinc Sulphate, Potash Alum

UNIT V (07 Hours)

Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.

BP110P. PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

(4 Hours / Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP110P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP110P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I **Limit tests for following ions**

Limit test for Chlorides and Sulphates

Modified limit test for Chlorides and Sulphates

Limit test for Iron

Limit test for Heavy metals

Limit test for Lead

Limit test for Arsenic

II **Identification test**

Magnesium hydroxide

Ferrous sulphate

Sodium bicarbonate

Calcium gluconate

Copper sulphate

III **Test for purity**

Swelling power of Bentonite

Neutralizing capacity of aluminum hydroxide gel

Determination of potassium iodate and iodine in potassium Iodide

IV **Preparation of inorganic pharmaceuticals**

Boric acid

Potash alum

Ferrous sulphate

Recommended Books (Latest Editions)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.

2. A.I. Vogel, Text Book of Quantitative Inorganic analysis

3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition

4. M.L Schroff, Inorganic Pharmaceutical Chemistry

5. Bentley and Driver's Textbook of Pharmaceutical Chemistry

6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry

7. Indian Pharmacopoeia

BP105T.COMMUNICATION SKILLS (Theory)

(30 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP105T	**2**	**2**	**2**	**0**	**2**	**30**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP105T	**5**	**10**	**1 Hr**	**15**	**35**	**1.5 Hrs**	**50**

Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.

Objectives:

Upon completion of the course the student shall be able to

1. Understand the behavioral needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
2. Communicate effectively (Verbal and Non Verbal)
3. Effectivelymanage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

Course content

UNIT-I (07 Hours)

Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process-Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context

Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers

Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment

UNIT-II (07 Hours)

Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication

Communication Styles: Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style

UNIT-III (07 Hours)

Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations

Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication

Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message

UNIT-IV (05 Hours)

Interview Skills: Purpose of an interview, Do's and Dont's of an interview

Giving Presentations: Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery

UNIT – V (04 Hours)

Group Discussion: Introduction, Communication skills in group discussion, Do's and Dont's of group discussion

BP111P.COMMUNICATION SKILLS (Practical)

(2 Hours / week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP111P	**2**	**1**	**2**	**25**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP111P	**5**	**5**	**2 Hr**	**10**	**15**	**2 Hrs**	**25**

The following learning modules are to be conducted using words worth® English language lab software

Basic communication covering the following topics

Meeting People

Asking Questions

Making Friends

What did you do?

Do's and Dont's

Pronunciations covering the following topics

Pronunciation (Consonant Sounds)

Pronunciation and Nouns

Pronunciation (Vowel Sounds)

Advanced Learning

Listening Comprehension / Direct and Indirect Speech

Figures of Speech

Effective Communication

Writing Skills

Effective Writing

Interview Handling Skills

E-Mail etiquette

Presentation Skills

Recommended Books: (Latest Edition)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011

2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011

3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013

4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011

5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013

6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010

7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals – PHI, 2011

8. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011

9. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011

10. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011

11. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009

12. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

BP 106 RBT. REMEDIAL BIOLOGY (Theory)

(30 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP105T	**2**	**2**	**2**	**0**	**2**	**30**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP105T	**5**	**10**	**1 Hr**	**15**	**35**	**1.5 Hrs**	**50**

Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.

Objectives: Upon completion of the course, the student shall be able to

1. know the classification and salient features of five kingdoms of life
2. understand the basic components of anatomy & physiology of plant
3. know understand the basic components of anatomy & physiology animal with special reference to human

UNIT-I (07 Hours)

Living world: Definition and characters of living organisms, Diversity in the living world Binomial nomenclature, Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus.

Morphology of Flowering plants : Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.

UNIT-II (07 Hours)

Body fluids and circulation : Composition of blood, blood groups, coagulation of blood Composition and functions of lymph, Human circulatory system, Structure of human heart and blood vessels, Cardiac cycle, cardiac output and ECG.

Digestion and Absorption: Human alimentary canal and digestive glands, Role of digestive enzymes, Digestion, absorption and assimilation of digested food.

Breathing and respiration : Human respiratory system, Mechanism of breathing and its regulation, Exchange of gases, transport of gases and regulation of respiration, Respiratory volumes.

UNIT-III (07 Hours)

Excretory products and their elimination: Modes of excretion, Human excretory system-structure and function, Urine formation, Rennin angiotensin system.

Neural control and coordination : Definition and classification of nervous system, Structure of a neuron, Generation and conduction of nerve impulse, Structure of brain and spinal cord, Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata.

Chemical coordination and regulation: Endocrine glands and their secretions, Functions of hormones secreted by endocrine glands.

Human reproduction: Parts of female reproductive system, Parts of male reproductive system, Spermatogenesis and Oogenesis, Menstrual cycle

UNIT-IV (05 Hours)

Plants and mineral nutrition: Essential mineral, macro and micronutrients, Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation.

Photosynthesis: Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.

UNIT V (04 Hours)

Plant respiration: Respiration, glycolysis, fermentation (anaerobic).

Plant growth and development: Phases and rate of plant growth, Condition of growth,Introduction to plant growth regulators.

Cell-The unit of life: Structure and functions of cell and cell organelles.Cell division

Tissues: Definition, types of tissues, location and functions.

Text Books

a. Text book of Biology by S. B. Gokhale

b. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

a. A Text book of Biology by B.V. Sreenivasa Naidu

b. A Text book of Biology by Naidu and Murthy

c. Botany for Degree students By A.C.Dutta.

d.Outlines of Zoology byM. Ekambaranatha ayyer and T. N. Ananthakrishnan.

e. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

BP 112 RBP.REMEDIAL BIOLOGY (Practical)

(30 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP112P	**2**	**1**	**2**	**25**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP112P	**5**	**5**	**2 Hr**	**10**	**15**	**2 Hrs**	**25**

1. Introduction to experiments in biology

a) Study of Microscope

b) Section cutting techniques

c) Mounting and staining

d) Permanent slide preparation

2. Study of cell and its inclusions

3. Study of Stem, Root, Leaf, seed, fruit, flower and their modifications

4. Detailed study of frog by using computer models

5. Microscopic study and identification of tissues pertinent to Stem, Root Leaf, seed, fruit and flower

6. Identification of bones

7. Determination of blood group

8. Determination of blood pressure

9. Determination of tidal volume

Reference Books

1. Practical human anatomy and physiology. by S.R.Kale and R.R.Kale.

2. A Manual of pharmaceutical biology practical by S.B.Gokhale, C.K.Kokate and S.P.Shriwastava.

3. Biology practical manual according to National core curriculum .Biology forum of Karnataka. Prof .M.J.H.Shafi

BP 106 RMT.REMEDIAL MATHEMATICS (Theory)

(30 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP106T	**2**	**2**	**2**	**0**	**2**	**30**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP105T	**5**	**10**	**1 Hr**	**15**	**35**	**1.5 Hrs**	**50**

Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Objectives: Upon completion of the course the student shall be able to:-

1. Know the theory and their application in Pharmacy

2. Solve the different types of problems by applying theory

3. Appreciate the important application of mathematics in Pharmacy

Course Content:

UNIT – I (06 Hours)

Partial fraction: Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction , Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics

Logarithms: Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.

Function*:* Real Valued function, Classification of real valued functions,

Limits and continuity : Introduction , Limit of a function, Definition of limit of a function ($\in$ - δ definition),

$$\lim_{x \to a} \frac{x^n - a^n}{x - a} = n\,a^{n-1}, \quad \lim_{\theta \to 0} \frac{\sin\theta}{\theta} = 1, \therefore$$

UNIT –II (06 Hours)

Matrices and Determinant: Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants , Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix , Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem,Applicationof Matrices in solving Pharmacokinetic equations

UNIT – III (06 Hours)

Calculus

Differentiation : Introductions, Derivative of a function, Derivative of a constant, Derivative of a product of a constant and a function , Derivative of the sum or difference of two functions, Derivative of the product of two functions (product formula), Derivative of the quotient of two functions (Quotient formula) – **Without Proof**, Derivative of *xn w.r.t*x,where *n* is any rational number, Derivative of *ex*,, Derivative of loge *x* , Derivative of *ax,* ,Derivative of trigonometric functions from first principles **(without Proof)**, Successive Differentiation, Conditions for a function to be a maximum or a minimum at a point. Application.

UNIT – IV (06 Hours)

Analytical Geometry

Introduction: Signs of the Coordinates, Distance formula,

Straight Line : Slope or gradient of a straight line, Conditions for parallelism and perpendicularity of two lines, Slope of a line joining two points, Slope – intercept form of a straight line

Integration: Introduction, Definition, Standard formulae, Rules of integration, Method of substitution, Method of Partial fractions, Integration by parts, definite integrals, application.

UNIT-V (06 Hours)

Differential Equations : Some basic definitions, Order and degree, Equations in separable form , Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations**

Laplace Transform : Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**

Recommended Books (Latest Edition)

1. Differential Calculus by Shanthinarayan

2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.

3. Integral Calculus by Shanthinarayan

4. Higher Engineering Mathematics by Dr.B.S.Grewal

B. PHARM. SECOND SEMESTER

Table-I: Course of study for semester II

Course Code	Name of the course	No. of hours	Tutorial	Credit points
BP201T	Human Anatomy and Physiology II – Theory	3	1	4
BP202T	Pharmaceutical Organic Chemistry I – Theory	3	1	4
BP203T	Biochemistry – Theory	3	1	4
BP204T	Pathophysiology – Theory	3	1	4
BP205T	Computer Applications in Pharmacy – Theory *	3	-	3
BP206T	Environmental sciences – Theory *	3	-	3
BP207P	Human Anatomy and Physiology II –Practical	4	-	2
BP208P	Pharmaceutical Organic Chemistry I– Practical	4	-	2
BP209P	Biochemistry – Practical	4	-	2
BP210P	Computer Applications in Pharmacy – Practical*	2	-	1
Total		**32**	**4**	**29**

*****Non University Examination (NUE)

Table-II: Scheme for Internal Assessments and end semester examinations

SEMESTER II

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP201T	Human Anatomy and Physiology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP202T	Pharmaceutical Organic Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP203T	Biochemistry – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP204T	Pathophysiology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP205T	Computer Applications in Pharmacy – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP206T	Environmental sciences – Theory*	10	15	1 Hr	25	50	2 Hrs	75
BP207P	Human Anatomy and Physiology II –Practical	5	10	4 Hr	15	35	4 Hrs	50
BP208P	Pharmaceutical Organic Chemistry I– Practical	5	10	4 Hr	15	35	4 Hrs	50
BP209P	Biochemistry – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP210P	Computer Applications in Pharmacy – Practical*	5	5	2 Hr	10	15	2 Hrs	25
		80	**125**	**20 Hrs**	**205**	**520**	**30 Hrs**	**725**

***** The subject experts at college level shall conduct examinations

BP 201T: HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP201T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP201T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Objectives: Upon completion of this course the student should be able to:

1. Explain the gross morphology, structure and functions of various organs of the human body.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

Unit I (10 hours)

Nervous system : Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts,reflex activity)

Unit II (06 hours)

Digestive system : Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

Energetics: Formation and role of ATP, Creatinine Phosphate and BMR.

Unit III (10 hours)

Respiratory system: Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration. Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

Urinary system : Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

Unit IV (10 hours)

Endocrine system : Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

Unit V (09 hours)

Reproductive system : Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

Introduction to genetics : Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

BP 207 P. HUMAN ANATOMY AND PHYSIOLOGY (Practical)

(4 Hours/week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP207P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP207P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject**.**

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc

4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index.
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

Recommended Books (Latest Editions)

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co,Riverview,MI USA
4. Text book of Medical Physiology- Arthur C,Guyton andJohn.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

Reference Books:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

BP202T. PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP202T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP202T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Objectives: Upon completion of the course the student shall be able to

1. Write the structure, name and the type of isomerism of the organic compound
2. Write the reaction, name the reaction and orientation of reactions
3. Account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound

Course Content:

- General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained
- To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

UNIT-I (07 Hours)

Classification, nomenclature and isomerism : Classification of Organic Compounds, Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds), Structural isomerisms in organic compounds

UNIT-II (10 Hours)

Alkanes*, Alkenes* and Conjugated dienes* : SP^3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins, Stabilities of alkenes, SP2 hybridization in alkenes.

E^1 and E^2 reactions- kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E^1 verses E^2 reactions, Factors affecting E^1 and E^2 reactions. Ozonolysis, electrophilic addition reactions of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

UNIT-III (10 Hours)

Alkyl halides*: SN^1 and SN^2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations. SN^1 versus SN^2 reactions, Factors affecting SN^1 and SN^2 reactions.

Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

UNIT-IV (10 Hours)

Carbonyl compounds* (Aldehydes and ketones) : Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

UNIT-V (08 Hours)

Carboxylic acids* : Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids ,amide and ester Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

Aliphatic amines*: Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine

BP208P. PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)

(4 Hours / week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP208P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP208P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Systematic qualitative analysis of unknown organic compounds like

    1. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.

2. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test

3. Solubility test

4. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.

5. Melting point/Boiling point of organic compounds

6. Identification of the unknown compound from the literature using melting point/ boiling point.

7. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.

8. Minimum 5 unknown organic compounds to be analysed systematically.

2. Preparation of suitable solid derivatives from organic compounds

3. Construction of molecular models

Recommended Books (Latest Editions)

1. Organic Chemistry byMorrison and Boyd

2. Organic Chemistry by I.L. Finar , Volume-I

3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.

4. Organic Chemistry by P.L.Soni

5. Practical Organic Chemistry byMann and Saunders.

6. Vogel's text book of Practical Organic Chemistry

7. Advanced Practical organic chemistry by N.K.Vishnoi.

8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

BP203 T. BIOCHEMISTRY (Theory)

45 Hours

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP203T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP203T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Objectives: Upon completion of course student shell be able to

1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.
3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

Course Content:

UNIT I (08 Hours)

Biomolecules : Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

Bioenergetics : Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

UNIT II (10 Hours)

Carbohydrate metabolism : Glycolysis-Pathway, energetics and significance, Citric acid cycle- Pathway, energetics and significance, HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency, Glycogen metabolism Pathways and glycogen storage diseases (GSD), Gluconeogenesis-Pathway and its significance, Hormonal regulation of blood glucose level and Diabetes mellitus

Biological oxidation : Electron transport chain (ETC) and its mechanism, Oxidative phosphorylation & its mechanism and substrate level phosphorylation, Inhibitors ETC and oxidative phosphorylation/Uncouplers

UNIT III (10 Hours)

Lipid metabolism : β-Oxidation of saturated fatty acid (Palmitic acid), Formation and utilization of ketone bodies; ketoacidosis, De novo synthesis of fatty acids (Palmitic acid), Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D, Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

Amino acid metabolism : General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders, Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia), Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline, Catabolism of heme; hyperbilirubinemia and jaundice.

UNIT IV (10 Hours)

Nucleic acid metabolism and genetic information transfer : Biosynthesis of purine and pyrimidine nucleotides, Catabolism of purine nucleotides and Hyperuricemia and Gout disease, Organization of mammalian genome, Structure of DNA and RNA and their functions, DNA replication (semi conservative model), Transcription or RNA synthesis, Genetic code, Translation or Protein synthesis and inhibitors

UNIT V (07 Hours)

Enzymes : Introduction, properties, nomenclature and IUB classification of enzymes, Enzyme kinetics (Michaelis plot, Line Weaver Burke plot), Enzyme inhibitors with examples, Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation, Therapeutic and diagnostic applications of enzymes and isoenzymes, Coenzymes –Structure and biochemical functions

BP 209 P. BIOCHEMISTRY (Practical)

4 Hours / Week

Course code	Credit hours	Credit points	Hrs./week	Marks
BP209P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP209P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)

3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

Recommended Books (Latest Editions)

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

BP 204T.PATHOPHYSIOLOGY (THEORY)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP204T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP204T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes.This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Objectives: Upon completion of the subject student shall be able to –

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

Course content

Unit I (10 Hours)

Basic principles of Cell injury and Adaptation: Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury**,** Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage)**,** Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia)**,** Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis &Alkalosis, Electrolyte imbalance

Basic mechanism involved in the process of inflammation and repair: Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis

Unit II (10Hours)

Cardiovascular System: Hypertension, congestive heart failure, ischemic heart disease (angina,myocardial infarction, atherosclerosis and arteriosclerosis)

Respiratory system : Asthma, Chronic obstructive airways diseases.

Renal system : Acute and chronic renal failure .

Unit II (10Hours)

Haematological Diseases: Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia

Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones

Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease.

Gastrointestinal system: Peptic Ulcer

Unit IV (8 Hours)

Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease.

Disease of bones and joints: Rheumatoid arthritis, osteoporosis and gout

Principles of cancer: classification, etiology and pathogenesis of cancer

Unit V (7 Hours)

Infectious diseases: Meningitis,Typhoid, Leprosy, Tuberculosis Urinary tract infections

Sexually transmitted diseases :AIDS, Syphilis, Gonorrhea

Recommended Books (Latest Editions)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.

2. HarshMohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.

3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.

4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;

5. William and Wilkins, Baltimore;1991 [1990 printing].

6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.

7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.

8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.

9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia; WB Saunders Company; 1997.

10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171 (Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

BP205 T. COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 Hrs (2 Hrs/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP205T	**3**	**3**	**2**	**30**	**75**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP205T	10	15	1 Hr	25	50	2 Hrs	75

Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Objectives: Upon completion of the course the student shall be able to

1. Know the various types of application of computers in pharmacy
2. Know the various types of databases
3. Know the various applications of databases in pharmacy

Course content:

UNIT-I (06 hours)

Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement ,Two's complement method, binary multiplication, binary division

Concept of Information Systems and Software: **I**nformation gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project

UNIT–II (06 hours)

Web technologies : Introduction to HTML, XML,CSS and Programming languages, introduction to web servers and Server Products

Introduction to databases, MYSQL, MS ACCESS, Pharmacy Drug database

UNIT–III (06 hours)

Application of computers in Pharmacy – Drug information storage and retrieval, Pharmacokinetics, Mathematical model in Drug design, Hospital and Clinical Pharmacy, Electronic Prescribing and discharge

(EP) systems, barcode medicine identification and automated dispensing of drugs, mobile technology and adherence monitoring

Diagnostic System, Lab-diagnostic System, Patient Monitoring System, Pharma Information System

UNIT–IV (06 hours)

Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery

UNIT-V (06 hours)

Computers as data analysis in Preclinical development: Chromatographic data analysis(CDS), Laboratory Information management System (LIMS) and Text Information Management System(TIMS)

BP 210P. COMPUTER APPLICATIONS IN PHARMACY (Practical)

2 Hours / Week

Course code	Credit hours	Credit points	Hrs./week	Marks
BP210P	**2**	**1**	**2**	**25**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP210P	**5**	**5**	**2 Hr**	**10**	**15**	**2 Hrs**	**25**

1. Design a questionnaire using a word processing package to gather information about a particular disease.
2. Create a HTML web page to show personal information.
3 Retrieve the information of a drug and its adverse effects using online tools
4 Creating mailing labels Using Label Wizard , generating label in MS WORD
5 Create a database in MS Access to store the patient information with the required fields Using access
6. Design a form in MS Access to view, add, delete and modify the patient record in the database
7. Generating report and printing the report from patient database
8. Creating invoice table using – MS Access
9. Drug information storage and retrieval using MS Access
10. Creating and working with queries in MS Access
11. Exporting Tables, Queries, Forms and Reports to web pages
12. Exporting Tables, Queries, Forms and Reports to XML pages

Recommended books (Latest edition):

1. Computer Application in Pharmacy-William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.

2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA

3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)

4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath-Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002

BP 206 T. ENVIRONMENTAL SCIENCES (Theory)

(30 hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP206T	**3**	**3**	**3**	**30**	**75**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP206T	10	15	1 Hr	25	50	2 Hrs	75

Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives: Upon completion of the course the student shall be able to**:**

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

Course content

Unit-I (10hours)

The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-II (10hours)

Ecosystems : Concept of an ecosystem, Structure and function of an ecosystem, Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- III (10hours)

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore

2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

3. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmadabad – 380 013, India,

4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

5. Clark R.S., Marine Pollution, Clanderson Press Oxford

6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p

7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.

8. Down of Earth, Centre for Science and Environment

B. PHARM. THIRD SEMESTER

Table-I: Course of study for semester III

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP301T	Pharmaceutical Organic Chemistry II – Theory	3	1	4
BP302T	Physical Pharmaceutics I – Theory	3	1	4
BP303T	Pharmaceutical Microbiology – Theory	3	1	4
BP304T	Pharmaceutical Engineering – Theory	3	1	4
BP305P	Pharmaceutical Organic Chemistry II – Practical	4	-	2
BP306P	Physical Pharmaceutics I – Practical	4	-	2
BP307P	Pharmaceutical Microbiology – Practical	4	-	2
BP308P	Pharmaceutical Engineering –Practical	4	-	2
	Total	**28**	**4**	**24**

Table-II: Scheme for Internal Assessments and end semester examinations

SEMESTER III

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP301T	Pharmaceutical Organic Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP302T	Physical Pharmaceutics I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP303T	Pharmaceutical Microbiology –Theory	10	15	1 Hr	25	75	3 Hrs	100
BP304T	Pharmaceutical Engineering – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP305P	Pharmaceutical Organic Chemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP306P	Physical Pharmaceutics I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP307P	Pharmaceutical Microbiology – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP308P	Pharmaceutical Engineering – Practical	5	10	4 Hr	15	35	4 Hrs	50
		60	**100**	**20 Hrs**	**160**	**440**	**28 Hrs**	**600**

BP301T. PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP301T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP301T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject deals with general methods of preparation and reactions of some organic compounds. Reactivity of organic compounds are also studied here. The syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Objectives: Upon completion of the course the student shall be able to

1. write the structure, name and the type of isomerism of the organic compound
2. write the reaction, name the reaction and orientation of reactions
3. account for reactivity/stability of compounds,
4. prepare organic compounds

Course Content:

General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained.

To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences.

UNIT I (10 Hours)

Benzene and its derivatives

A. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule

B. Reactions of benzene- nitration, sulphonation, halogenationreactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation.

C. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction

D. Structure and uses of DDT, Saccharin, BHC and Chloramine

UNIT II (10 Hours)

Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols

Aromatic Amines* - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts

Aromatic Acids* –Acidity, effect of substituents on acidity and important reactions of benzoic acid.

UNIT III (10 Hours)

Fats and Oils

a. Fatty acids-reactions.

b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils.

c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value-significance and principle involved in their determination.

UNIT IV (08 Hours)

Polynuclear hydrocarbons:

a. Synthesis, reactions

b.Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives

UNIT V (07 Hours)

Cyclo alkanes* : Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane only.

BP305P. PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

(4 Hrs/week)

Course code	Credit hours	Credit points	Hrs./week	Marks
BP305P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP305P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I Experiments involving laboratory techniques

Recrystallization

Steam distillation

II Determination of following oil values (including standardization of reagents)

Acid value

Saponification value

Iodine value

III **Preparation of compounds**

Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol /Aniline by acylation reaction.

2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/

Acetanilide by halogenation (Bromination) reaction.

5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.

Benzoic acid from Benzyl chloride by oxidation reaction.

Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.

1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions.

Benzil from Benzoin by oxidation reaction.

Dibenzal acetone from Benzaldehyde by Claison Schmidt reaction

Cinnammic acid from Benzaldehyde by Perkin reaction

P-Iodo benzoic acid from *P*-amino benzoic acid

Recommended Books (Latest Editions)

1. Organic Chemistry byMorrison and Boyd

2. Organic Chemistry by I.L. Finar , Volume-I

3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.

4. Organic Chemistry by P.L.Soni

5. Practical Organic Chemistry byMann and Saunders.

6. Vogel's text book of Practical Organic Chemistry

7. Advanced Practical organic chemistry by N.K.Vishnoi.

8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

BP302T. PHYSICAL PHARMACEUTICS-I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP302T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP302T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Content

UNIT-I (10 Hours)

Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partiallymiscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications

UNIT-II (10Hours)

States of Matter and properties of matter: State of matter, changes in the state of matter, latent heats, vapour pressure, sublimation critical point, eutectic mixtures, gases, aerosols – inhalers, relative humidity, liquid complexes, liquid crystals, glassy states, solidcrystalline, amorphous & polymorphism.

Physicochemical properties of drug molecules: Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications

UNIT-III (08 Hours)

Surface and interfacial phenomenon: Liquid interface, surface & interfacial tensions, surface free energy, measurement of surface & interfacial tensions, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB Scale, solubilisation, detergency, adsorption at solid interface.

UNIT-IV (08Hours)

Complexation and protein binding: Introduction, Classification of Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.

UNIT-V (07 Hours)

pH, buffers and Isotonic solutions: Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.

BP306P. PHYSICAL PHARMACEUTICS – I (Practical)

(4 Hrs/week)

Course code	Credit hours	Credit points	Hrs./week	Marks
BP306P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP306P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Determination the solubility of drug at room temperature
2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
3. Determination of Partition co- efficient of benzoic acid in benzene and water
4. Determination of Partition co- efficient of Iodine in CCl4 and water
5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
6. Determination of surface tension of given liquids by drop count and drop weight method
7. Determination of HLB number of a surfactant by saponification method

8. Determination of Freundlich and Langmuir constants using activated char coal
9. Determination of critical micellar concentration of surfactants
10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin
2. Experimental Pharmaceutics by Eugene, Parott.
3. Tutorial Pharmacy by Cooper and Gunn.
4. Stocklosam J. Pharmaceutical Calculations, Lea &Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, MarcelDekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical Dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C and ManavalanR.
8. LaboratoryManual of Physical Pharmaceutics, C.V.S. Subramanyam, J. Thimma settee
9. Physical Pharmaceutics by C.V.S. Subramanyam
10. Test book of Physical Phramacy, by Gaurav Jain & Roop K. Khar

BP 303 T. PHARMACEUTICAL MICROBIOLOGY (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP303T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP303T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope :

Study of all categories of microorganisims especially for the production of alchol antibiotics, vaccines, vitamins enzymes etc..

Objectives: Upon completion of the subject student shall be able to;

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of sterlization in pharmaceutical processing and industry
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

Course content

Unit I (10 Hours)

Introduction, history of microbiology, its branches, scope and its importance, Introduction to Prokaryotes and Eukaryotes, Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase constrast microscopy, dark field microscopy and electron microscopy.

Unit II (10 Hours)

Identification of bacteria using staining techniques (simple, Gram's &Acid fast staining) and biochemical tests (IMViC), Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous,radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipments employed in large scale sterilization. Sterility indicators.

Unit III (10 Hours)

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants ,Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

Unit IV (08 Hours)

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.

Unit V (07Hours)

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.

BP 307P.PHARMACEUTICAL MICROBIOLOGY (Practical)

(4 Hrs/week)

Course code	Credit hours	Credit points	Hrs./week	Marks
BP307P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP307P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.
2. Sterilization of glassware, preparation and sterilization of media.
3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.
4. Staining methods- Simple, Grams staining and acid fast staining (Demonstration with practical).
5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.
6. Microbiological assay of antibiotics by cup plate method and other methods
7. Motility determination by Hanging drop method.
8. Sterility testing of pharmaceuticals.
9. Bacteriological analysis of water
10. Biochemical test.

Recommended Books (Latest edition)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. I.P., B.P., U.S.P.Latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergers manual of systematic bacteriology, Williams and Wilkins- A Waverly company

BP 304 T. PHARMACEUTICAL ENGINEERING (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP304T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP304T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Objectives: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

Course content:

UNIT-I (10 Hours)

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II (10 Hours)

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator& Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation,flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation.

UNIT- III (08 Hours)

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV (08 Hours)

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V (07 Hours)

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

Recommended Books: (Latest Editions)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.

2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.

3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.

4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest edition.

5. Remington practice of pharmacy- Martin, Latest edition.

6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.

7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.

8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP308P - PHARMACEUTICAL ENGINEERING (Practical)

(4 Hours/week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP308P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP308P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I. Determination of radiation constant of brass, iron, unpainted and painted glass.

II. Steam distillation – To calculate the efficiency of steam distillation.

III. To determine the overall heat transfer coefficient by heat exchanger.

IV. Construction of drying curves (for calcium carbonate and starch).

V. Determination of moisture content and loss on drying.

VI. Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method.

VII. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.

VIII. Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots.

IX. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.

X. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.

XI. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity

XII. To study the effect of time on the Rate of Crystallization.

XIII. To calculate the uniformity Index for given sample by using Double Cone Blender.

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B. PHARM. FOURTH SEMESTER

Table-I: Course of study for semester IV

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP401T	Pharmaceutical Organic Chemistry III– Theory	3	1	4
BP402T	Medicinal Chemistry I – Theory	3	1	4
BP403T	Physical Pharmaceutics II – Theory	3	1	4
BP404T	Pharmacology I – Theory	3	1	4
BP405T	Pharmacognosy and Phytochemistry I– Theory	3	1	4
BP406P	Medicinal Chemistry I – Practical	4	-	2
BP407P	Physical Pharmaceutics II – Practical	4		2
BP408P	Pharmacology I – Practical	4	-	2
BP409P	Pharmacognosy and Phytochemistry I – Practical	4	-	2
Total		**31**	**5**	**28**

Table II: Scheme for Internal Assessments and end semester examinations

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP401T	Pharmaceutical Organic Chemistry III– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP402T	Medicinal Chemistry I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP403T	Physical Pharmaceutics II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP404T	Pharmacology I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP405T	Pharmacognosy I – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP406P	Medicinal Chemistry I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP407P	Physical Pharmaceutics II –Practical	5	10	4 Hr	15	35	4 Hrs	50
BP408P	Pharmacology I – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP409P	Pharmacognosy I – Practical	5	10	4 Hr	15	35	4 Hrs	50
Total		**70**	**115**	**21 Hr**	**185**	**515**	**31 Hr**	**700**

BP401T. PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP401T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP401T	10	15	1 Hr	25	75	3 Hrs	100

Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Objectives: At the end of the course, the student shall be able to

1. Understand the methods of preparation and properties of organic compounds
2. Explain the stereo chemical aspects of organic compounds and stereo chemical reactions
3. Know the medicinal uses and other applications of organic compounds

Course Content

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT-I (10 Hours)

Stereo isomerism : Optical isomerism: Optical activity, enantiomerism, diastereoisomerism, meso compounds, Elements of symmetry, chiral and achiral molecules, DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers, Reactions of chiral molecules, Racemic modification and resolution of racemic mixture. Asymmetric synthesis: partial and absolute

UNIT-II (10 Hours)

Geometrical isomerism : Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity. Stereospecific and stereoselective reactions

UNIT-III (10 Hours)

Heterocyclic compounds: Nomenclature and classification. Synthesis, reactions and medicinal uses of following compounds/derivatives : Pyrrole, Furan, and Thiophene. Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

UNIT-IV (8 Hours)

Synthesis, reactions and medicinal uses of following compounds/derivatives: Pyrazole, Imidazole, Oxazole and Thiazole. Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine. Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

UNIT-V (07 Hours)

Reactions of synthetic importance: Metal hydride reduction ($NaBH_4$ and $LiAlH_4$), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation

Recommended Books (Latest Editions)

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry byMorrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

BP402T. MEDICINAL CHEMISTRY – I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP402T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP402T	10	15	1 Hr	25	75	3 Hrs	100

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

1. understand the chemistry of drugs with respect to their pharmacological activity
2. understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. know the Structural Activity Relationship (SAR) of different class of drugs
4. write the chemical synthesis of some drugs

Course Content

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I (10 Hours)

Introduction to Medicinal Chemistry: History and development of medicinal chemistry, Physicochemical properties in relation to biological action, Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism : Drug metabolism principles- Phase I and Phase II, Factors affecting drug metabolism including stereo chemical aspects.

UNIT- II (10 Hours)

Drugs acting on Autonomic Nervous System

Adrenergic Neurotransmitters: Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution.

Sympathomimetic agents: SAR of Sympathomimetic agents : Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.

Agents with mixed mechanism: Ephedrine, Metaraminol.

Adrenergic Antagonists: Alpha adrenergic blockers: Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*, Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

UNIT-III (10 Hours)

Cholinergic neurotransmitters: Biosynthesis and catabolism of acetylcholine, Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

Parasympathomimetic agents: SAR of Parasympathomimetic agents

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV (08 Hours)

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturtes: SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital

Miscelleneous: Amides & imides: Glutethmide. Alcohol & their carbamate derivatives: Meprobomate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazeines: SAR of Phenothiazeines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Trifluprомazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazeines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants**,** mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas**: Phenacemide, Carbamazepine*

Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

UNIT – V (07 Hours)

Drugs acting on Central Nervous System

General anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbitutrates: Methohexital sodium*, Thiamylal sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine hydrochloride.*

Narcotic and non-narcotic analgesics

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepriac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone.

BP406P. MEDICINAL CHEMISTRY – I (Practical)

(4 Hours/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP406P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP406P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I Preparation of drugs/ intermediates

1 1,3-pyrazole

2 1,3-oxazole

3 Benzimidazole

4 Benztriazole

5 2,3- diphenyl quinoxaline

6 Benzocaine

7 Phenytoin

8 Phenothiazine

9 Barbiturate

II Assay of drugs

1 Chlorpromazine

2 Phenobarbitone

3 Atropine

4 Ibuprofen

5 Aspirin

6 Furosemide

III Determination of Partition coefficient for any two drugs

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.

2. Foye's Principles of Medicinal Chemistry.

3. Burger's Medicinal Chemistry, Vol I to IV.

4. Introduction to principles of drug design- Smith and Williams.

5. Remington's Pharmaceutical Sciences.

6. Martindale's extra pharmacopoeia.

7. Organic Chemistry by I.L. Finar, Vol. II.

8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.

9. Indian Pharmacopoeia.

10. Text book of practical organic chemistry- A.I.Vogel.

BP 403 T. PHYSICAL PHARMACEUTICS-II (Theory)

(45Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP403T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP403T	10	15	1 Hr	25	75	3 Hrs	100

Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Objectives: Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.

Course Content

UNIT-I (07 Hours)

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties.

Effect of electrolytes, coacervation, peptization& protective action.

UNIT-II (10 Hours)

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

UNIT-III (10 Hours)

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

UNIT-IV(10Hours)

Micromeretics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

UNIT-V (10 Hours)

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.

BP 407P. PHYSICAL PHARMACEUTICS- II (Practical)

(4 Hrs/week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP407P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP407P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Determination of particle size, particle size distribution using sieving method
2. Determination of particle size, particle size distribution using Microscopic method
3. Determination of bulk density, true density and porosity
4. Determine the angle of repose and influence of lubricant on angle of repose

5. Determination of viscosity of liquid using Ostwald's viscometer

6. Determination sedimentation volume with effect of different suspending agent

7. Determination sedimentation volume with effect of different concentration of single suspending agent

8. Determination of viscosity of semisolid by using Brookfield viscometer

9. Determination of reaction rate constant first order.

10. Determination of reaction rate constant second order

11. Accelerated stability studies

Recommended Books: (Latest Editions)

1. Physical Pharmacy by Alfred Martin, Sixth edition

2. Experimental pharmaceutics by Eugene, Parott.

3. Tutorial pharmacy by Cooper and Gunn.

4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.

5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.

6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3. Marcel Dekkar Inc.

7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

BP 404 T. PHARMACOLOGY-I (Theory)

(45 Hrs)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP401T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP401T	10	15	1 Hr	25	75	3 Hrs	100

Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Objectives: Upon completion of this course the student should be able to

1. Understand the pharmacological actions of different categories of drugs
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. Observe the effect of drugs on animals by simulated experiments
5. Appreciate correlation of pharmacology with other bio medical sciences

Course Content

UNIT-I (08 hours)

1. General Pharmacology

a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.

b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

UNIT-II (12 Hours)

General Pharmacology

a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein–coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.

b. Adverse drug reactions.

c. Drug interactions (pharmacokinetic and pharmacodynamic)

d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

UNIT-III (10 Hours)

2. Pharmacology of drugs acting on peripheral nervous system

a. Organization and function of ANS.

b. Neurohumoral transmission,co-transmission and classification of neurotransmitters.

c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.

d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).

e. Local anesthetic agents.

f. Drugs used in myasthenia gravis and glaucoma

UNIT-IV (08 Hours)

3. Pharmacology of drugs acting on central nervous system

a. Neurohumoral transmission in the C.N.S.special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.

b. General anesthetics and pre-anesthetics**.**

c. Sedatives, hypnotics and centrally acting muscle relaxants.

d. Anti-epileptics

e. Alcohols and disulfiram

UNIT-V (07 Hours)

3. Pharmacology of drugs acting on central nervous system

a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.

b. Drugs used in Parkinsons disease and Alzheimer's disease.

c. CNS stimulants and nootropics.

d. Opioid analgesics and antagonists

e. Drug addiction, drug abuse, tolerance and dependence.

BP 408 P.PHARMACOLOGY-I (Practical)

(4Hrs/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP408P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP408P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology,.Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams &Wilkins

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher

8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

10. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

BP 405 T.PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
BP401T	**4**	**4**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP401T	10	15	1 Hr	25	75	3 Hrs	100

Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

Objectives: Upon completion of the course, the student shall be able

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

Course Content

UNIT-I (10 Hours)

Introduction to Pharmacognosy:

(a) Definition, history, scope and development of Pharmacognosy

(b) Sources of Drugs – Plants, Animals, Marine & Tissue culture

(c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT-II (10 Hours)

Cultivation, Collection, Processing and storage of drugs of natural origin: Cultivation and Collection of drugs of natural origin, Factors influencing cultivation of medicinal plants, Plant hormones and their applications, Polyploidy, mutation and hybridization with reference to medicinal plants. Conservation of medicinal plants.

UNIT-III (07 Hours)

Plant tissue culture: Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines

UNIT IV (10 Hours)

Pharmacognosy in various systems of medicine: Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

UNIT V (08 Hours)

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

Plant Products: Fibers - Cotton, Jute, Hemp. Hallucinogens, Teratogens, Natural allergens

Primary metabolites: General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primarymetabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs: Novel medicinal agents from marine sources

BP409 P. PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

(4 Hours/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP409P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP409P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Analysis of crude drugs by chemical tests: **(**i)Tragaccanth (ii) Acacia (iii)Agar (iv) Gelatin (v) starch (vi) Honey (vii) Castor oil
2. Determination of stomatal number and index
3. Determination of vein islet number, vein islet termination and paliside ratio.
4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer
5. Determination of Fiber length and width
6. Determination of number of starch grains by Lycopodium spore method
7. Determination of Ash value
8. Determination of Extractive values of crude drugs
9. Determination of moisture content of crude drugs
10. Determination of swelling index and foaming

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs byM.A. Iyengar

B. PHARM. FIFTH SEMESTER

Table-I: Course of study for semester V

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP501T	Medicinal Chemistry II – Theory	3	1	4
BP502T	Industrial Pharmacy I– Theory	3	1	4
BP503T	Pharmacology II – Theory	3	1	4
BP504T	Pharmacognosy II – Theory	3	1	4
BP505Y	Pharmaceutical Jurisprudence – Theory	3	1	4
BP506P	Industrial Pharmacy I– Practical	4	-	2
BP507P	Pharmacology II – Practical	4	-	2
BP 508P	Pharmacognosy II – Practical	4	-	2
	Total	**27**	**5**	**26**

Table-II: Scheme for Internal Assessments and end semester examinations

SEMESTER V

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP501T	Medicinal Chemistry II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP502T	Industrial Pharmacy I– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP503T	Pharmacology II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP504T	Pharmacognosy and Phytochemistry II– Theory	10	15	1 Hr	25	75	3 Hrs	100
BP505T	Pharmaceutical Jurisprudence – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP506P	Industrial PharmacyI – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP507P	Pharmacology II – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP508P	Pharmacognosy and Phytochemistry II – Practical	5	10	4 Hr	15	35	4 Hrs	50
		65	**105**	**17 Hrs**	**170**	**480**	**27 Hrs**	**650**

BP501T. MEDICINAL CHEMISTRY – II (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP501T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP501T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Objectives: Upon completion of the course the student shall be able to

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

Course Content

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I (10 Hours)

Antihistaminic agents: Histamine, receptors and their distribution in the human body

H_1-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium. **H_2-antagonists:**

Cimetidine*, Famotidine, Ranitidin. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

Anti-neoplastic agents: Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine. **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin. **Plant products:** Etoposide, Vinblastin sulphate, Vincristin sulphate. **Miscellaneous:** Cisplatin, Mitotane.

UNIT – II (10 Hours)

Anti-anginal: **Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics: Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide. Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride. Osmotic Diuretics: Mannitol

Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride,* Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide,Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT- III (10 Hours)

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol.

Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol

Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel

Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT- IV (08 Hours)

Drugs acting on Endocrine system: Nomenclature, Stereochemistry and metabolism of steroids

Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.

Drugs for erectile dysfunction: Sildenafil, Tadalafil.

Oral contraceptives: Mifepristone, Norgestril, Levonorgestrol

Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone

Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT– V (07 Hours)

Antidiabetic agents: Insulin and its preparations, Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone. Meglitinides: Repaglinide, Nateglinide. Glucosidase inhibitors: Acrabose, Voglibose.

Local Anesthetics: SAR of Local anesthetics, **Benzoic Acid derivatives**; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **Amino Benzoic acid derivatives**: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives**: Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous**: Phenacaine, Diperodon, Dibucaine.*

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP 502 T. Industrial Pharmacy I (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP502T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP502T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Objectives: Upon completion of the course the student shall be able to

1. Know the various pharmaceutical dosage forms and their manufacturing techniques.
2. Know various considerations in development of pharmaceutical dosage forms
3. Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

UNIT-I (07 Hours)

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

UNIT-II (10 Hours)

Tablets:

a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling.

b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating.

c. Quality control tests: In process and finished product tests

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

UNIT-III (08 Hours)

Capsules:

a. ***Hard gelatin capsules:*** Introduction, Production of hard gelatin capsule shells. size of capsules, Filling, finishing and special techniques of formulation of hard gelatine capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. ***Soft gelatin capsules:*** Nature of shell and capsule content, size of capsules,importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

UNIT-IV (10 Hours)

Parenteral Products:

a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity

b. Production procedure, production facilities and controls, aseptic processing

c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products.

d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations

UNIT-V (10 Hours)

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers,

stability aspects of packaging materials, quality control tests.

BP 506 P. Industrial Pharmacy I (Practical)

4 Hours/week

Course code	Credit hours	Credit points	Hrs./week	Marks
BP506P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP506P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Preformulation studies on paracetamol/asparin/or any other drug
2. Preparation and evaluation of Paracetamol tablets
3. Preparation and evaluation of Aspirin tablets
4. Coating of tablets- film coating of tables/granules
5. Preparation and evaluation of Tetracycline capsules
6. Preparation of Calcium Gluconate injection
7. Preparation of Ascorbic Acid injection
8. Qulaity control test of (as per IP) marketed tablets and capsules
9. Preparation of Eye drops/ and Eye ointments
10. Preparation of Creams (cold / vanishing cream)
11. Evaluation of Glass containers (as per IP)

Recommended Books: (Latest Editions)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman &J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman

7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition

8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5thedition, 2005

9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107.

BP503.T. PHARMACOLOGY-II (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP503T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP503T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition,emphasis on the basic concepts of bioassay.

Objectives: Upon completion of this course the student should be able to

1. Understand the mechanism of drug action and its relevance in the treatment of different diseases
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
3. Demonstrate the various receptor actions using isolated tissue preparation
4. Appreciate correlation of pharmacology with related medical sciences

Course Content

UNIT-I (10hours)

1. Pharmacology of drugs acting on cardio vascular system

a. Introduction to hemodynamic and electrophysiology of heart.

b. Drugs used in congestive heart failure

c. Anti-hypertensive drugs.

d. Anti-anginal drugs.

e. Anti-arrhythmic drugs.

f. Anti-hyperlipidemic drugs.

UNIT-II (10hours)

1. Pharmacology of drugs acting on cardio vascular system

a. Drug used in the therapy of shock.

b. Hematinics, coagulants and anticoagulants.

c. Fibrinolytics and anti-platelet drugs

d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

a. Diuretics

b. Anti-diuretics.

UNIT-III (10hours)

3. Autocoids and related drugs

a. Introduction to autacoids and classification

b. Histamine, 5-HT and their antagonists.

c. Prostaglandins, Thromboxanes and Leukotrienes.

d. Angiotensin, Bradykinin and Substance P.

e. Non-steroidal anti-inflammatory agents

f. Anti-gout drugs

g. Antirheumatic drugs

UNIT-IV (08 hours)

5. Pharmacology of drugs acting on endocrine system

a. Basic concepts in endocrine pharmacology.

b. Anterior Pituitary hormones- analogues and their inhibitors.

c. Thyroid hormones- analogues and their inhibitors.

d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.

d. Insulin, Oral Hypoglycemic agents and glucagon.

e. ACTH and corticosteroids.

UNIT-V (07 hours)

5. Pharmacology of drugs acting on endocrine system

a. Androgens and Anabolic steroids.

b. Estrogens, progesterone and oral contraceptives.

c. Drugs acting on the uterus.

6. Bioassay

a. Principles and applications of bioassay.

b.Types of bioassay

c. Bioassay of insulin, oxytocin, vasopressin, ACTH,d-tubocurarine,digitalis, histamine and 5-HT

BP 507 P. PHARMACOLOGY-II (Practical)

(4Hrs/Week)

Course code	Credit hours	Credit points	Hrs./week	Marks
BP507P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP507P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD2 value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.

3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.

6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher

8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.

9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.

10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

BP504 T. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP504T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP504T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Objectives: Upon completion of the course, the student shall be able

1. to know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. to understand the preparation and development of herbal formulation.
3. to understand the herbal drug interactions
4. to carryout isolation and identification of phytoconstituents

Course Content

UNIT-I (7 Hours)

Metabolic pathways in higher plants and their determination

a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.

b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-II (14 Hours)

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis

Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,

Tannins: Catechu, Pterocarpus

Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony

Glycosides: Senna, Aloes, Bitter Almond

Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

UNIT-III (06 Hours)

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrhetinic acid & Rutin

c) Alkaloids: Atropine,Quinine,Reserpine,Caffeine

d) Resins: Podophyllotoxin, Curcumin

UNIT-IV (10 Hours)

Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

UNIT V (8 Hours)

Basics of Phytochemistry

Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

BP 508 P. PHARMACOGNOSY AND PHYTOCHEMISTRY II (Practical)

(4 Hours/Week)

Course code	Credit hours	Credit points	Hrs./week	Marks
BP508P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP508P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander

2. Exercise involving isolation & detection of active principles

a. Caffeine - from tea dust.

b. Diosgenin from Dioscorea

c. Atropine from Belladonna

d. Sennosides from Senna

3. Separation of sugars by Paper chromatography

4. TLC of herbal extract

5. Distillation of volatile oils and detection of phytoconstitutents by TLC

6. Analysis of crude drugs by chemical tests: **(**i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

Recommended Books: (Latest Editions)

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.

2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.

3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.

4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.

5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007

6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.

7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.

8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.

9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.

10. The formulation and preparation of cosmetic, fragrances and flavours.

11. Remington's Pharmaceutical sciences.

12. Text Book of Biotechnology by Vyas and Dixit.

13. Text Book of Biotechnology by R.C. Dubey.

BP 505 T. PHARMACEUTICAL JURISPRUDENCE (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP505T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP505T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Objectives: Upon completion of the course, the student shall be able to understand:

1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
2. Various Indian pharmaceutical Acts and Laws
3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. The code of ethics during the pharmaceutical practice

Course Content:

UNIT-I (10 Hours)

Drugs and Cosmetics Act, 1940 and its rules 1945: Objectives, Definitions, Legal definitions of schedules to the Act and Rules. Import of drugs-Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties**.** Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

UNIT-II (10 Hours)

Drugs and Cosmetics Act, 1940 and its rules 1945 : Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences

and penalties. Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

UNIT-III (10 Hours)

Pharmacy Act –1948: Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties

Medicinal and Toilet Preparation Act –1955: Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations.

Offences and Penalties.

Narcotic Drugs and Psychotropic substances Act-1985 and Rules: Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

UNIT-IV (08 Hours)

Study of Salient Features of Drugs and Magic Remedies Act and its rules: Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties

Prevention of Cruelty to animals Act-1960: Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties

National Pharmaceutical Pricing Authority: Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

UNIT-V (07 Hours)

Pharmaceutical Legislations-A brief review, Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee

Code of Pharmaceutical ethics D efinition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath

Medical Termination of Pregnancy Act

Right to Information Act

Introduction to Intellectual Property Rights (IPR)

Recommended books: (Latest Edition)

1. Forensic Pharmacy by B. Suresh
2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-byM.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9.Bare Acts of the said laws published by Government. Reference books (Theory)

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B. PHARM. SIXTH SEMESTER

Table-I: Course of study for semester VI

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP601T	Medicinal Chemistry III – Theory	3	1	4
BP602T	Pharmacology III – Theory	3	1	4
BP603T	Herbal Drug Technology – Theory	3	1	4
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	3	1	4
BP605T	Pharmaceutical Biotechnology – Theory	3	1	4
BP606T	Quality Assurance –Theory	3	1	4
BP607P	Medicinal chemistry III – Practical	4	-	2
BP608P	Pharmacology III – Practical	4	-	2
BP609P	Herbal Drug Technology – Practical	4	-	2
	Total	**30**	**6**	**30**

Table-II: Scheme for Internal Assessments and end semester examinations

SEMESTER VI

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP601T	Medicinal Chemistry III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP602T	Pharmacology III – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP603T	Herbal Drug Technology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP604T	Biopharmaceutics and Pharmacokinetics – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP605T	Pharmaceutical Biotechnology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP606T	Quality Assurance –Theory	10	15	1 Hr	15	75	3 Hrs	100
BP607P	Medicinal chemistry III – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP608P	Pharmacology III – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP609P	Herbal Drug Technology – Practical	5	10	4 Hr	15	35	4 Hrs	50
		75	**120**	**18 Hrs**	**195**	**555**	**30 Hrs**	**750**

BP601T. MEDICINAL CHEMISTRY – III (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP601T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP601T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Objectives: Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

Course Content

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

UNIT – I (10 Hours)

Antibiotics : Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cepholosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline,Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II (10 Hours)

Antibiotics : Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunete, Artemether, Atovoquone.

UNIT – III (10 Hours)

Anti-tubercular Agents : Synthetic anti tubercular agents: Isoniozid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.* **Anti tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycine, Capreomycin sulphate.

Urinary tract anti-infective agents : Quinolones: SAR of quinolones, Nalidixic Acid,Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin. **Miscellaneous:** Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents: Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV (08 Hours)

Antifungal agents: Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconozole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones : Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxaole*, Sulphadiazine, Mefenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones:** Dapsone*.

UNIT – V (07 Hours)

Introduction to Drug Design : Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications chemistry: solid phase and solution phase synthesis. of combinatorial

BP607P. MEDICINAL CHEMISTRY- III (Practical)

(4 Hours / week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP607P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP607P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

I Preparation of drugs and intermediates

1 Sulphanilamide

2 7-Hydroxy, 4-methyl coumarin

3 Chlorobutanol

4 Triphenyl imidazole

5 Tolbutamide

6 Hexamine

II Assay of drugs

1 Isonicotinic acid hydrazide

2 Chloroquine

3 Metronidazole

4 Dapsone

5 Chlorpheniramine maleate

6 Benzyl penicillin

III Preparation of medicinally important compounds or intermediates byMicrowave irradiation technique

IV Drawing structures and reactions using chem draw®

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)

Recommended Books (Latest Editions)

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

BP602 T. PHARMACOLOGY-III (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP602T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP602T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition,emphasis on the principles of toxicology and chronopharmacology.

Objectives: Upon completion of this course the student should be able to:

1. understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
2. comprehend the principles of toxicology and treatment of various poisonings and
3. appreciate correlation of pharmacology with related medical sciences.

Course Content:

UNIT-I (10hours)

1. Pharmacology of drugs acting on Respiratory system

a. Anti -asthmatic drugs

b. Drugs used in the management of COPD

c. Expectorants and antitussives

d. Nasal decongestants

e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

a. Antiulcer agents.

b. Drugs for constipation and diarrhoea.

c. Appetite stimulants and suppressants.

d. Digestants and carminatives.

e. Emetics and anti-emetics.

UNIT-II (10hours)

3. Chemotherapy

a. General principles of chemotherapy.

b. Sulfonamides and cotrimoxazole.

c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolins, tetracycline and aminoglycosides

UNIT-III (10hours)

3. Chemotherapy

a. Antitubercular agents

b. Antileprotic agents

c. Antifungal agents

d. Antiviral drugs

e.Anthelmintics

f. Antimalarial drugs

g. Antiamoebic agents

UNIT-IV (08hours)

3. Chemotherapy

l. Urinary tract infections and sexually transmitted diseases.

m. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants

b. Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

UNIT-V (07hours)

5. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.

b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

c. General principles of treatment of poisoning

d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning.

6. Chronopharmacology

a. Definition of rhythm and cycles.

b. Biological clock and their significance leading to chronotherapy.

BP 608 P. PHARMACOLOGY-III (Practical)

(4Hrs/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP608P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP608P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyser
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens (rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substance
12. Determination of acute eye irritation / corrosion of a test substance
13. Calculation of pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology(student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

**Experiments are demonstrated by simulated experiments/videos*

Recommended Books (Latest Editions)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics

4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams &Wilkins

5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology

6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.

7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert,

8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,

9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,

10. N.Udupa and P.D. Gupta, Concepts in Chronopharmacology.

BP 603 T. HERBAL DRUG TECHNOLOGY (Theory)

(45 hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP603T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP603T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

Objectives: Upon completion of this course the student should be able to:

1. understand raw material as source of herbal drugs from cultivation to herbal drug product
2. know the WHO and ICH guidelines for evaluation of herbal drugs
3. know the herbal cosmetics, natural sweeteners, nutraceuticals
4. appreciate patenting of herbal drugs, GMP .

Course content:

UNIT-I (11 Hours)

Herbs as raw materials : Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs

Selection, identification and authentication of herbal materials Processing of herbal raw material

Biodynamic Agriculture : Good agricultural practices in cultivation of medicinal plants including Organic farming.

Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

Indian Systems of Medicine : a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy

b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma.

UNIT-II (7 Hours)

Nutraceuticals : General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT-III (10 Hours)

Herbal Cosmetics : Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

Herbal formulations : Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

UNIT- IV (10 Hours)

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:

a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy

b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

UNIT-V (07 Hours)

General Introduction to Herbal Industry : Herbal drugs industry: Present scope and future prospects.

A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

S**chedule T-GoodManufacturing Practice of Indian systems of medicine :** Components of GMP (Schedule – T) and its objectives, Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

BP 609 P. HERBAL DRUG TECHNOLOGY (Practical)

(4 hours/ week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP609P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP609P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

BP 604 T. BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP604T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP604T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Objectives: Upon completion of the course student shall be able to:

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance.
2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

Course Content:

UNIT-I (10Hours)

Introduction to Biopharmaceutics

Absorption; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs

UNIT- II (10 Hours)

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, *in-vitro* drug dissolution models, *in-vitro-in-vivo*

correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT- III (10 Hours)

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE ,t1/2,Vd,AUC,Ka, Clt and CLR- definitions methods of eliminations, understanding of their significance and application

UNIT- IV (08 Hours)

Multicompartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and mainetnance doses and their significance in clinical settins.

UNIT- V (07 Hours)

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

Recommended Books: (Latest Editions)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.

2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari

3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernational edition.USA

4. Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,Vallabh Prakashan Pitampura, Delhi

5. Pharmacokinetics: ByMilo Glbaldi Donald, R. Mercel Dekker Inc.

6. Hand Book of Clinical Pharmacokinetics, ByMilo Gibaldi and Laurie Prescott by ADIS Health Science Press.

7. Biopharmaceutics; By Swarbrick

8. Clinical Pharmacokinetics, Concepts and Applications: ByMalcolm Rowland and

9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.

10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company,Pennsylvania 1989.

11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.

12. Remington's Pharmaceutical Sciences, ByMack Publishing Company, Pennsylvnia

BP 605 T. PHARMACEUTICAL BIOTECHNOLOGY (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP605T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP605T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope:

- Biotechnology has a long promise to revolutionize the biological sciences and technology.
- Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technologymakes the subject interesting.
- Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs.
- Biotechnology has already produced transgenic crops and animals and the future promises lot more.
- It is basically a research-based subject.

Objectives: Upon completion of the subject student shall be able to;

1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

Unit I (10 Hours)

a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.

b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.

c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.

d) Brief introduction to Protein Engineering.

e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.

f) Basic principles of genetic engineering.

Unit II (10 Hours)

a) Study of cloning vectors, restriction endonucleases and DNA ligase.

b) Recombinant DNA technology. Application of genetic engineering in medicine.

c) Application of r DNA technology and genetic engineering in the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.

d) Brief introduction to PCR

Unit III (10 Hours)

Types of immunity- humoral immunity, cellular immunity

a) Structure of Immunoglobulins

b) Structure and Function of MHC

c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.

d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.

e) Storage conditions and stability of official vaccines

f) Hybridoma technology- Production, Purification and Applications

g) Blood products and Plasma Substituties.

Unit IV (08Hours)

a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.

b) Genetic organization of Eukaryotes and Prokaryotes

c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.

d) Introduction to Microbial biotransformation and applications.

e) Mutation: Types of mutation/mutants.

Unit V (07 Hours)

a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.

b) Large scale production fermenter design and its various controls.

c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,

d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substituties.

Recommended Books (Latest edition):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.

2. RA Goldshy et. al., : Kuby Immunology.

3. J.W. Goding: Monoclonal Antibodies.

4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.

5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.

6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.

7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

BP606 T PHARMACEUTICAL QUALITY ASSURANCE (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP606T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP606T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to:

1. understand the cGMP aspects in a pharmaceutical industry
2. appreciate the importance of documentation
3. understand the scope of quality certifications applicable to pharmaceutical industries
4. understand the responsibilities of QA & QC departments

Course content:

UNIT – I (10 Hours)

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines

Quality by design (QbD): Definition, overview, elements of QbD program, tools

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration

NABL accreditation : Principles and procedures

UNIT - II (10 Hours)

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

UNIT – III (10 Hours)

Quality Control: Quality control test for containers, rubber closures and secondary packing materials.

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities

UNIT – IV (08 Hours)

Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

UNIT – V (07 Hours)

Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

Warehousing: Good warehousing practice, materials management

Recommended Books: (Latest Edition)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.

2. Good Laboratory Practice Regulations, 2nd Edition, SandyWeinberg Vol. 69.

3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol IWHO Publications.

4. A guide to Total QualityManagement- Kushik Maitra and Sedhan K Ghosh

5. How to Practice GMP's – P P Sharma.

6. ISO 9000 and Total QualityManagement – Sadhank G Ghosh

7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms

8. Good laboratory Practices – Marcel Deckker Series

9. ICH guidelines, ISO 9000 and 14000 guidelines

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B. PHARM. SEVENTH SEMESTER

Table-I: Course of study for semester VII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP701T	Instrumental Methods of Analysis – Theory	3	1	4
BP702T	Industrial Pharmacy II – Theory	3	1	4
BP703T	Pharmacy Practice – Theory	3	1	4
BP704T	Novel Drug Delivery System – Theory	3	1	4
BP705P	Instrumental Methods of Analysis – Practical	4	-	2
BP706PS	Practice School*	12	-	6
	Total	**28**	**5**	**24**

Table-II: Scheme for Internal Assessments and end semester examinations

Semester VII

Course code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP701T	Instrumental Methods of Analysis – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP702T	Industrial Pharmacy II – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP703T	Pharmacy Practice – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP704T	Novel Drug Delivery System – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP705P	Instrumental Methods of Analysis – Practical	5	10	4 Hr	15	35	4 Hrs	50
BP706PS	Practice School*	25	-	-	25	125	5 Hrs	150
		70	**70**	**8 Hrs**	**140**	**460**	**21 Hrs**	**600**

BP701T. INSTRUMENTAL METHODS OF ANALYSIS (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP701T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP701T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

Course Content:

UNIT –I (10 Hours)

UV Visible spectroscopy : Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications - Spectrophotometric titrations, Single component and multi component analysis

Fluorimetry : Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

UNIT –II (10 Hours)

IR spectroscopy : Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations. Instrumentation - Sources of radiation,

wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications.

Flame Photometry-Principle, interferences, instrumentation and applications

Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications

Nepheloturbidometry- Principle, instrumentation and applications

UNIT –III (10 Hours)

Introduction to chromatography

Adsorption and partition column chromatography-Methodology, advantages, disadvantages and applications.

Thin layer chromatography- Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications.

Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications

Electrophoresis– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

UNIT –IV (08 Hours)

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

UNIT –V (07 Hours)

Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel chromatography- Introduction, theory, instrumentation and applications

Affinity chromatography- Introduction, theory, instrumentation and applications

BP705P. INSTRUMENTAL METHODS OF ANALYSIS (Practical)

(4 Hours/Week)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP705P	**4**	**2**	**4**	**50**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP705P	**5**	**10**	**4 Hr**	**15**	**35**	**4 Hrs**	**50**

1 Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds

2 Estimation of dextrose by colorimetry

3 Estimation of sulfanilamide by colorimetry

4 Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy

5 Assay of paracetamol by UV- Spectrophotometry

6 Estimation of quinine sulfate by fluorimetry

7 Study of quenching of fluorescence

8 Determination of sodium by flame photometry

9 Determination of potassium by flame photometry

10 Determination of chlorides and sulphates by nephelo turbidometry

11 Separation of amino acids by paper chromatography

12 Separation of sugars by thin layer chromatography

13 Separation of plant pigments by column chromatography

14 Demonstration experiment on HPLC

15 Demonstration experiment on Gas Chromatography

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma

2. Organic spectroscopy by Y.R Sharma

3. Text book of Pharmaceutical Analysis by Kenneth A. Connors

4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel

5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake

6. Organic Chemistry by I. L. Finar

7. Organic spectroscopy byWilliam Kemp

8. Quantitative Analysis of Drugs by D. C. Garrett

9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi

10. Spectrophotometric identification of Organic Compounds by Silverstein

BP 702 T. INDUSTRIAL PHARMACYII (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP702T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP702T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Objectives: Upon completion of the course, the student shall be able to:

1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

Course Content:

UNIT-I (10 Hours)

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

UNIT-II (10 Hours)

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

UNIT-III (10 Hours)

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals

Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.

UNIT-IV (08 Hours)

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP

UNIT-V (07 Hours)

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

Recommended Books: (Latest Editions)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http,//en.wikipedia.org/wiki/Regulatory_ Affairs.

2.International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php

3. Douglas J Pisano and David S. Mantus. Text book of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.

4.Regulatory Affairs brought by learning plus, inc. available at http.//www.cgmp.com/ra.htm.

BP 703 T. PHARMACY PRACTICE (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP703T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP703T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Objectives: Upon completion of the course, the student shall be able to

1. know various drug distribution methods in a hospital
2. appreciate the pharmacy stores management and inventory control
3. monitor drug therapy of patient through medication chart review and clinical review
4. obtain medication history interview and counsel the patients
5. identify drug related problems
6. detect and assess adverse drug reactions
7. interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. know pharmaceutical care services
9. do patient counseling in community pharmacy;
10. appreciate the concept of Rational drug therapy.

Unit I: (10 Hours)

a) Hospital and it's organization : Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.

b) Hospital pharmacy and its organization : Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.

c) Adverse drug reaction : Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial

interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.

d) **Community Pharmacy :** Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

Unit II: (10 Hours)

a) Drug distribution system in a hospital : Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.

b) Hospital formulary : Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

c) Therapeutic drug monitoring : Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic DrugMonitoring, and Indian scenario for Therapeutic Drug Monitoring.

d) Medication adherence : Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

e) Patient medication history interview : Need for the patient medication history interview, medication interview forms.

f) Community pharmacy management : Financial, materials, staff, and infrastructure requirements.

Unit III: (10 Hours)

a) Pharmacy and therapeutic committee : Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

b) Drug information services : Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

c) Patient counselling Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

d) Education and training program in the hospital : Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing

homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

e) Prescribed medication order and communication skills : Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

Unit IV (8 Hours)

a) Budget preparation and implementation : Budget preparation and implementation

b) Clinical Pharmacy : Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

c) Over the counter (OTC) sales : Introduction and sale of over the counter, and Rational use of common over the counter medications.

Unit V (7 Hours)

a) Drug store management and inventory control : Organisation of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

b) Investigational use of drugs : Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

c) Interpretation of Clinical Laboratory Tests : Blood chemistry, hematology, and urinalysis

Recommended Books (Latest Edition):

1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.

2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills*, 1st ed. Chennai: Orient Longman Private Limited; 2004.

3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger; 1986.

4. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008.

5. Scott LT. *Basic skills in interpreting laboratory data*, 4thed. American Society of Health System Pharmacists Inc; 2009.

6. Parmar N.S. *Health Education and Community Pharmacy*, 18th ed. India: CBS Publishers & Distributers; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356

2. Journal of pharmacy practice. ISSN : 0974-8326

3. American journal of health system pharmacy. ISSN: 1535-2900 (online)

4. Pharmacy times (Monthly magazine)

BP 704T: NOVEL DRUG DELIVERY SYSTEMS (Theory)

(45 Hours)

Course of study

Course code	Credit hours	Credit points	Hrs./week			Teaching Hrs/semester	Marks
			L	T	Total		
BP704T	**4**	**4**	**3**	**1**	**4**	**45**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP704T	**10**	**15**	**1 Hr**	**25**	**75**	**3 Hrs**	**100**

Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Objectives: Upon completion of the course student shall be able

1. To understand various approaches for development of novel drug delivery systems.

2. To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

Course content:

Unit-I (10 Hours)

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates.Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations

Polymers: Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

Unit-II (10 Hours)

Microencapsulation: Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications

Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implantsand osmotic pump

Unit-III (10 Hours)

Transdermal Drug Delivery Systems: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems and their applications

Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers

Unit-IV (08 Hours)

Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications

Unit-V (07 Hours)

Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts

Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, development of intra uterine devices (IUDs) and applications

Recommended Books: (Latest Editions)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.

2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.

3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim

4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).

5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

BP706 PS: Practice School

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
BP706PS	**12**	**6**	**-**	**150**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
BP706PS	**25**	**-**	**4**	**25**	**125**	**5 Hrs**	**150**

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Table-I: Course of study for semester VIII

Course code	Name of the course	No. of hours	Tutorial	Credit points
BP801T	Biostatistics and Research Methodology	3	1	4
BP802T	Social and Preventive Pharmacy	3	1	4
BP803ET	Pharma Marketing Management			
BP804ET	Pharmaceutical Regulatory Science			
BP805ET	Pharmacovigilance			
BP806ET	Quality Control and Standardization of Herbals	3 + 3 =	1 + 1 = 2	4 + 4 =
BP807ET	Computer Aided Drug Design	6		8
BP808ET	Cell and Molecular Biology			
BP809ET	Cosmetic Science			
BP810ET	Experimental Pharmacology			
BP811ET	Advanced Instrumentation Techniques			
BP812ET	Dietary Supplements and Nutraceuticals			
BP813PW	Project Work	12	-	6
	Total	**24**	**4**	**22**

Table-II: Scheme for Internal Assessments and end semester examinations

Semester VIII

Course Code	Name of the course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
BP801T	Biostatistics and Research Methodology – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP802ET	Social and Preventive Pharmacy – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP803ET	Pharmaceutical Marketing – Theory	10	15	1 Hr	25	75	3 Hrs	100
BP804ET	Pharmaceutical Regulatory Science – Theory	10 + 10 = 20	15+15 = 30	1 + 1 = 2 Hrs	25 + 25 = 50	75 + 75 = 150	3 + 3 = 6 Hrs	100 + 100 = 200
BP805ET	Pharmacovigilance – Theory							
BP806ET	Quality Control and Standardization of Herbals – Theory							
BP807ET	Computer Aided Drug Design – Theory							
BP808ET	Cell and Molecular Biology – Theory							
BP809ET	Cosmetic Science – Theory							
BP810ET	Experimental Pharmacology – Theory							
BP811ET	Advanced Instrumentation Techniques – Theory							
BP812PW	Project Work	-	-	-	-	150	4 Hrs	150
		40	**60**	**4 Hrs**	**100**	**450**	**16 Hrs**	**550**

***** The subject experts at college level shall conduct examinations

BP801T. BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)

(45 Hours)

Scope: To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel**.**

Objectives: Upon completion of the course the student shall be able to

1. Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
2. Know the various statistical techniques to solve statistical problems
3. Appreciate statistical techniques in solving the problems**.**

Course content

Unit-I (10 Hours)

Introduction: Statistics, Biostatistics, Frequency distribution

Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples

Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems

Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

Unit-II (10 Hours)

Regression: Curve fitting by the method of least squares, fitting the lines y= a + bx and x = a + by, Multiple regression, standard error of regression-Pharmaceutical Examples

Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties-problems. Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples

Parametric test: t-test (Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference

Unit-III (10 Hours)

Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test

Introduction to Research: Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism

Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph

Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies, Experimental studies, Designing clinical trial, various phases.

Unit-IV (8 Hours)

Blocking and confounding system for Two-level factorials

Regression modelling: Hypothesis testing in Simple and Multiple regression models

Introduction to Practical components of Industrial and Clinical Trials Problems:

Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical trial approach

Unit-V (7Hours)

Design and Analysis of experiments:

Factorial Design: Definition, 22, 23design. Advantage of factorial design

Response Surface methodology: Central composite design, Historical design, Optimization Techniques

Recommended Books (Latest edition):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.

2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha

3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,

4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

BP 802T SOCIAL AND PREVENTIVE PHARMACY

(45 Hours)

Scope:

The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Objectives:

After the successful completion of this course, the student shall be able to:

1. Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
2. Have a critical way of thinking based on current healthcare development.
3. Evaluate alternative ways of solving problems related to health and pharmaceutical issues

Course content:

Unit I (10 Hours)

Concept of health and disease: Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.

Social and health education: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.

Sociology and health: Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health

Hygiene and health: personal hygiene and health care; avoidable habits

Unit II (10 Hours)

Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse

Unit III (10 Hours)

National health programs, its objectives, functioning and outcome of the following:

HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

Unit IV (08 Hours)

National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program

Unit V (07 Hours)

Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

Recommended Books (Latest edition)*:*

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications

2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications

3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications

4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications

5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.

6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

BP803ET. PHARMA MARKETING MANAGEMENT (Theory)

(45 Hours)

Scope:

The pharmaceutical industry not only needs highly qualified researchers, chemists and, technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Course Objective: The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

Unit I (10 Hours)

Marketing: Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical market: Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting.Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist.Analyzing the Market;Role of market research.

Unit II (10 Hours)

Product decision: Classification, product line and product mix decisions, product life cycle,product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

Unit III (10 Hours)

Promotion: Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.

Unit IV (10 Hours)

Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

Professional sales representative (PSR): Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

Unit V (10 Hours)

Pricing: Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order)and NPPA (National Pharmaceutical Pricing Authority).

Emerging concepts in marketing: Vertical & Horizontal Marketing; RuralMarketing; Consumerism; Industrial Marketing; Global Marketing.

Recommended Books: (Latest Editions)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi

2. Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.

3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill

4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India

5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

6. Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, Indian Context,Macmilan India, New Delhi.

7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi

8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

BP804 ET: PHARMACEUTICAL REGULATORY SCIENCE (Theory)

(45 Hours)

Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia,UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Objectives: Upon completion of the subject student shall be able to;

1. Know about the process of drug discovery and development
2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
3. Know the regulatory approval process and their registration in Indian and international markets

Course content:

Unit I (10Hours)

New Drug Discovery and development : Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

Unit II (10Hours)

Regulatory Approval Process: Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies: Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

Unit III (10Hours)

Registration of Indian drug product in overseas market : Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research.

Unit IV (08Hours)

Clinical trials : Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safetymonitoring in clinical trials

Unit V (07Hours)

Regulatory Concepts : Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book

Recommended books (Latest edition):

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / SandyWeinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition By Rick Ng

BP 805T: PHARMACOVIGILANCE (Theory)

(45 hours)

Scope: This paper will provide an opportunity for the student to learn about development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, global scenario of Pharmacovigilance, train students on establishing pharmacovigilance programme in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

Objectives:

At completion of this paper it is expected that students will be able to (know, do, and appreciate):

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs
7. Adverse drug reaction reporting systems and communication in pharmacovigilance
8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
9. Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
12. CIOMS requirements for ADR reporting
13. Writing case narratives of adverse events and their quality.

Course Content

Unit I (10 Hours)

Introduction to Pharmacovigilance : History and development of Pharmacovigilance, Importance of safety monitoring of Medicine, WHO international drug monitoring programme, Pharmacovigilance Program of India(PvPI)

Introduction to adverse drug reactions : Definitions and classification of ADRs, Detection and reporting, Methods in Causality assessment, Severity and seriousness assessment, Predictability and preventability assessment, Management of adverse drug reactions

Basic terminologies used in pharmacovigilance : Terminologies of adverse medication related events, Regulatory terminologies

Unit II 10 hours

Drug and disease classification: Anatomical, therapeutic and chemical classification of drugs, International classification of diseases, Daily defined doses, International Non proprietary Names for drugs

Drug dictionaries and coding in pharmacovigilance : WHO adverse reaction terminologies, MedDRA and Standardised MedDRA queries, WHO drug dictionary, Eudravigilance medicinal product dictionary

Information resources in pharmacovigilance : Basic drug information resources, Specialised resources for ADRs

Establishing pharmacovigilance programme : Establishing in a hospital, Establishment & operation of drug safety department in industry, Contract Research Organisations (CROs), Establishing a national programme

Unit III 10 Hours

Vaccine safety surveillance: Vaccine Pharmacovigilance, Vaccination failure, Adverse events following immunization

Pharmacovigilance methods : Passive surveillance-Spontaneous reports and case series, Stimulated reporting, Active surveillance- Sentinel sites, drug event monitoring and registries, Comparative observational studies – Cross sectional study, case control study and cohort study, Targeted clinical investigations

Communication in pharmacovigilance : Effective communication in Pharmacovigilance, Communication in Drug Safety Crisis management, Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

Unit IV (8 Hours)

Safety data generation : Pre clinical phase, Clinical phase, Post approval phase (PMS)

ICH Guidelines for Pharmacovigilance : Organization and objectives of ICH, Expedited reporting, Individual case safety reports, Periodic safety update reports, Post approval expedited reporting, Pharmacovigilance planning, Good clinical practice in pharmacovigilance studies

Unit V (7 hours)

Pharmacogenomics of adverse drug reactions : Genetics related ADR with example focusing PK parameters.

Drug safety evaluation in special population : Paediatrics, Pregnancy and lactation, Geriatrics

CIOMS : CIOMS Working Groups, CIOMS Form

CDSCO (India) and Pharmacovigilance : D&C Act and Schedule Y, Differences in Indian and global pharmacovigilance requirements

Recommended Books (Latest edition):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance:Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller,Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert,Jones& Bartlett Publishers.
7. Textbook of Pharmacoepidemiolog edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy,Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills:G. Parthasarathi, Karin NyfortHansen,Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297
13. http://www.ich.org/
14. http://www.cioms.ch/
15. http://cdsco.nic.in/
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

BP 806 ET. QUALITY CONTROL AND STANDARDIZATION OF HERBALS

(Theory)

Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

Objectives: Upon completion of the subject student shall be able to;

1. know WHO guidelines for quality control of herbal drugs
2. know Quality assurance in herbal drug industry
3. know the regulatory approval process and their registration in Indian and international markets
4. appreciate EU and ICH guidelines for quality control of herbal drugs

Unit I (10 hours)

Basic tests for drugs-Pharmaceutical substances, Medicinal plants materials and dosage forms, WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use

Unit II (10 hours)

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines. WHO Guidelines on GACP for Medicinal Plants.

Unit III (10 hours)

EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

Unit IV (08 hours)

Stability testing of herbal medicines.Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.

Unit V (07 hours)

Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems. Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products

Recommended Books: (Latest Editions

1. Pharmacognosy by Trease and Evans

2. Pharmacognosy by Kokate, Purohit and Gokhale

3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.

4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.

5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,

6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.

8. WHO. Quality Control Methods for Medicinal Plant Materials,World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.

9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.

10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.

11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.

12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP 807 ET. COMPUTER AIDED DRUG DESIGN (Theory)

(45 Hours)

Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

Objectives: Upon completion of the course, the student shall be able to understand

1. Design and discovery of lead molecules
2. The role of drug design in drug discovery process
3. The concept of QSAR and docking
4. Various strategies to develop new drug like molecules.
5. The design of new drug molecules using molecular modeling software

Course Content:

UNIT-I (10 Hours)

Introduction to Drug Discovery and Development : Stages of drug discovery and development

Lead discovery and Analog Based Drug Design : Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

UNIT-II (10 Hours)

Quantitative Structure Activity Relationship (QSAR) : SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant.

Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-III (10 Hours)

Molecular Modeling and virtual screening techniques Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

UNIT-IV (08 Hours)

Informatics & Methods in drug design : Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

UNIT-V (07 Hours)

Molecular Modeling: Introduction to molecular mechanics and quantum mechanics.Energy Minimization methods and Conformational Analysis, global conformational minima determination.

Recommended Books (Latest Editions)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.

2. Martin YC. "Quantitative Drug Design" Dekker, New York.

3. Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.

4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.

5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.

6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" JohnWiley& Sons, New York.

7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.

8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.

9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

BP808ET: CELL AND MOLECULAR BIOLOGY (Elective subject)

(45 Hours)

Scope:

- Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organismssuch as humans, plants, and sponges.

Objectives: Upon completion of the subject student shall be able to;

1. Summarize cell and molecular biology history.
2. Summarize cellular functioning and composition.
3. Describe the chemical foundations of cell biology.
4. Summarize the DNA properties of cell biology.
5. Describe protein structure and function.
6. Describe cellular membrane structure and function.
7. Describe basic molecular genetic mechanisms.
8. Summarize the Cell Cycle

Course content:

Unit I (10Hours)

a) Cell and Molecular Biology: Definitions theory and basics and Applications.

b) Cell and Molecular Biology: History and Summation.

c) Properties of cells and cell membrane.

d) Prokaryotic versus Eukaryotic

e) Cellular Reproduction

f) Chemical Foundations – an Introduction and Reactions (Types)

Unit II 10 Hours

a) DNA and the Flow of Molecular Information

b) DNA Functioning

c) DNA and RNA

d) Types of RNA

e) Transcription and Translation

Unit III 10 Hours

a) Proteins: Defined **and** Amino Acids

b) Protein Structure

c) Regularities in Protein Pathways

d) Cellular Processes

e) Positive Control and significance of Protein Synthesis

Unit IV (08 Hours)

a) Science of Genetics

b) Transgenics and Genomic Analysis

c) Cell Cycle analysis

d) Mitosis and Meiosis

e) Cellular Activities and Checkpoints

Unit V (07 Hours)

a) Cell Signals: Introduction

b) Receptors for Cell Signals

c) Signaling Pathways: Overview

d) Misregulation of Signaling Pathways

e) Protein-Kinases: Functioning

Recommended Books (latest edition):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.

2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.

3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.

4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.

5. Rose: Industrial Microbiology.

6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan

7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.

8. Peppler: Microbial Technology.

9. Edward: Fundamentals of Microbiology.

10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi

11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C.

13. RA Goldshy et. al., : Kuby Immunology.

BP809ET. COSMETIC SCIENCE (Theory)

(45Hours)

UNIT I (10Hours)

Classification of cosmetic and cosmeceutical products, Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

Cosmetic excipients: Surfactants, rheologymodifiers, humectants, emollients, preservatives. Classification and application

Skin: Basic structure and function of skin.

Hair: Basic structure of hair. Hair growth cycle.

Oral Cavity: Common problem associated with teeth and gums**.**

UNIT II (10 Hours)

Principles of formulation and building blocks of skin care products:

Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages.Application of these products in formulation of cosmecuticals.

Antiperspants & deodorants- Actives & mechanism of action.

Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hair conditioner,anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phylene diamine based hair dye. Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

UNIT III (10 Hours)

Sun protection, Classification of Sunscreens and SPF.

Role of herbs in cosmetics:

Skin Care: Aloe and turmeric

Hair care: Henna and amla.

Oral care: Neem and clove

Analytical cosmetics: BIS specification and analytical methods for shampoo, skincream and toothpaste**.**

UNIT IV (08 Hours.)

Principles of Cosmetic Evaluation:Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps,and syndet bars. Evolution and skin benfits.

UNIT V (07 Hours)

Oily and dry skin, causes leading to dry skin, skin moisturisation. Basic understanding of the terms Comedogenic, dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes. Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action

References

1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.

2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.

3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

BP810 ET. PHARMACOLOGICAL SCREENINGMETHODS

(45 Hours)

Scope: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

Objectives

Upon completion of the course the student shall be able to,

1. Appreciate the applications of various commonly used laboratory animals.
2. Appreciate and demonstrate the various screening methods used in preclinical research
3. Appreciate and demonstrate the importance of biostatistics and researchmethodology
4. Design and execute a research hypothesis independently

Unit –I (08 Hours)

Laboratory Animals: Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.

Unit –II (10 Hours)

Preclinical screening models

a. Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study.

b. **Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's,antiasthmatics

Preclinical screening models: for CNS activity- analgesic, antipyretic,anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease

Unit –III

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaethetics

Unit –IV

Preclinical screening models: For CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti aggregatory, coagulants, and anticoagulants, Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.

Unit –IV (5 Hours)

Research methodology and Bio-statistics : Selection of research topic, review of literature, research hypothesis and study design, Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data

Recommended Books (latest edition):

1. Fundamentals of experimental Pharmacology-byM.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

BP 811 ET. ADVANCED INSTRUMENTATION TECHNIQUES

(45 Hours)

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

1. understand the advanced instruments used and its applications in drug analysis
2. understand the chromatographic separation and analysis of drugs.
3. understand the calibration of various analytical instruments
4. know analysis of drugs using various analytical instruments.

Course Content:

UNIT-I (10 Hours)

Nuclear Magnetic Resonance spectroscopy : Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications

Mass Spectrometry- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications

UNIT-II (10 Hours)

Thermal Methods of Analysis: Principles, instrumentation and applications of ThermogravimetricAnalysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, Xray Crystallography, rotating crystal technique, single crystal diffraction,powder diffraction, structural elucidation and applications.

UNIT-III (10 Hours)

Calibration and validation-as per ICH and USFDA guidelines

Calibration of following Instruments : Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC

UNIT-IV (08 Hours)

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay

Extraction techniques:General principle and procedure involved in the solid phase extraction and liquid-liquid extraction

UNIT-V (07 Hours)

Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.

Recommended Books (Latest Editions)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy byWilliam Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP 812 ET. DIETARY SUPPLEMENTS AND NUTRACEUTICALS

(No. of hours: 3 Tutorial: 1 Credit point:4)

Scope :

This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.

Objective:

This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to :

1. Understand the need of supplements by the different group of people to maintain healthy life.
2. Understand the outcome of deficiencies in dietary supplements.
3. Appreciate the components in dietary supplements and the application.
4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

UNIT I (07 hours)

a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.

b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.

c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

UNIT II (15 hours)

Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following

a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin

b) Sulfides: Diallyl sulfides, Allyl trisulfide.

c) Polyphenolics: Reservetrol

d) Flavonoids- Rutin , Naringin, Quercitin, Anthocyanidins, catechins, Flavones

e) Prebiotics / Probiotics.: Fructo oligosaccharides, Lacto bacillum

f) Phyto estrogens : Isoflavones, daidzein, Geebustin, lignans

g) Tocopherols

h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT III (07 hours)

a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.

b) Dietary fibres and complex carbohydrates as functional food ingredients.

UNIT IV(10 hours)

a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing.

b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α- Lipoic acid, melatonin

Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.

c) Functional foods for chronic disease prevention

UNIT V (06 hours)

a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.

b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.

c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

References:

1. Dietetics by Sri Lakshmi

2. Role of dietary fibres and neutraceuticals in preventing diseases by K.T Agusti and P.Faizal: BSPunblication.

3. Advanced Nutritional Therapies by Cooper. K.A., (1996).

4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).

5. Prescription for Nutritional Healing by James F.Balch and Phyllis A.Balch 2nd Edn., Avery Publishing Group, NY (1997).

6. G. Gibson and C.williams Editors *2000 Functional foods* Woodhead Publ.Co.London.

7. Goldberg, I. *Functional Foods*. 1994. Chapman and Hall, New York.

8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf Life Testing in *Essentials of Functional Foods* M.K. Sachmidl and T.P. Labuza eds. Aspen Press.

9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)

10. Shils, ME, Olson, JA, Shike, M. 1994 *Modern Nutrition in Health and Disease*. Eighth edition. Lea and Febiger

DEVI AHILYA VISHWAVIDYALAYA, INDORE

SCHOOL OF PHARMACY

M.PHARM.

SYLLABUS

(Prescribed by Pharmacy Council of India)

w.e.f academic session 2016-17

M. PHARM. PHARMACEUTICAL CHEMISTRY (MPC)

FIRST SEMESTER

Table 1: Course of study

Course code	Course	Credit hours	Credit points	Hrs./week	Marks
MPC 101 T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPC 102 T	Advanced Organic Chemistry-I	4	4	4	100
MPC 103 T	Advanced Medicinal Chemistry	4	4	4	100
MPC 104 T	Chemistry of Natural Products	4	4	4	100
MPC 105 T	Pharmaceutical Chemistry Practical I	12	6	12	150
	Seminar/Assignment	7	4	7	100
	Total	**35**	**26**	**35**	**650**

Table 2: Scheme for Internal Assessments and end semester examinations

Course code	Course	Internal Assessment				End semester exams		Total Marks
		Continuous mode	Sessional Exams.		Total	Marks	Duration	
			Marks	Duration				
MPC 101 T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3Hrs	100
MPC 102 T	Advanced Organic Chemistry-I	10	15	1 Hr	25	75	3Hrs	100
MPC 103 T	Advanced Medicinal Chemistry	10	15	1 Hr	25	75	3Hrs	100
MPC 104 T	Chemistry of Natural Products	10	15	1 Hr	25	75	3Hrs	100
MPC 105 T	Pharmaceutical Chemistry Practical I	20	30	6 Hr	50	100	6Hrs	150
-	Seminar/Assignment	-	-	-	-	-		100
		Total						**650**

MPC 101T: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 101 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 101 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Objectives

After completion of course student is able to know about:

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments

Unit 1 (10 Hrs.)

a. UV-Visible spectroscopy: Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

b. IR spectroscopy: Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.

c. Spectroflourimetry: Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

d. Flame emission spectroscopy and Atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

Unit 2 (10 Hrs.)

NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy.

Unit 3 (10 Hrs.)

Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of

Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

Unit 4 (10 Hrs.)

Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

a. Thin Layer chromatography
b. High Performance Thin Layer Chromatography
c. Ion exchange chromatography
d. Column chromatography
e. Gas chromatography
f. High Performance Liquid chromatography
g. Ultra High Performance Liquid chromatography
h. Affinity chromatography, Gel Chromatography

Unit 5 (10 Hrs.)

a. Electrophoresis: Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing

b. X ray Crystallography: Production of X rays, Different X ray methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction

Unit 6 (10 Hrs.)

a. Potentiometry: Principle, working, Ion selective Electrodes and Application of potentiometry.

b. Thermal Techniques: Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.Differential Thermal Analysis (DTA): Principle, instrumentationand advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

REFERENCES

1 Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2 Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3 Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

5 Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991

6 Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997

7 Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol. 11, Marcel. Dekker Series

8 Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.

9 Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 1982.

MPC 102T: ADVANCED ORGANIC CHEMISTRY - I

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 102 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 102 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall be to understand

- The principles and applications of reterosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions
- The chemistry of heterocyclic compounds

Unit 1 (12 Hrs.)

Basic Aspects of Organic Chemistry:

1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.

2. Types of reaction mechanisms and methods of determining them.

3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

Addition reactions: 1.Nucleophilic uni- and bimolecular reactions (SN1 and SN2)

2. Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule) 3. Rearrangement reactions.

Unit 2 (12 Hrs.)

Study of mechanism and synthetic applications of following named Reactions: Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction.

Unit 3 (12 Hrs.)

Synthetic Reagents & Applications: Aluminium isopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-

yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP).

Protecting groups : a. Role of protection in organic synthesis, b. Protection for the hydroxyl group, including 1,2-and1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals, c. Protection for the Carbonyl Group: Acetals and Ketals, d. Protection for the Carboxyl Group: amides and hydrazides, esters, e. Protection for the Amino Group and Amino acids: carbamates and amides.

Unit 4 (12 Hrs.)

Heterocyclic Chemistry: Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these hetrocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine,Theophylline , Mercaptopurine and Thioguanine.

Unit 5 (12 Hrs.)

Synthon approach and retrosynthesis applications: **a**. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA) **b**. C-X disconnections; C-C disconnections- alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds **c.** Strategies for synthesis of three, four, five and six-membered ring.

REFERENCES

1 Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.

2 Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.

3 Organic Chemistry, Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.

4 Organic Chemistry, Vol I and II. I.L. Finar. ELBS, Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,

5 A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).

6 Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.

7 Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell

8 Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)

9 Organic Synthesis - The Disconnection Approach, S. Warren, Wily India

10 Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.

11 Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.

12 Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

MPC 103 T: ADVANCED MEDICINAL CHEMISTRY

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 103 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 103 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Different stages of drug discovery
- Role of medicinal chemistry in drug research
- Different techniques for drug discovery
- Various strategies to design and develop new drug like molecules for biological targets
- Peptidomimetics

Unit 1 (12 Hrs.)

Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets.

Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.

Unit 2 (12 Hrs.)

Prodrug Design and Analog design:

a) Prodrug design: Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.

b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

c) Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

Unit 3 (12 Hrs.)

Medicinal chemistry aspects of the following class of drugs Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs:

a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

b) Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

Unit 4 (12 Hrs.)

Rational Design of Enzyme Inhibitors Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

Unit 5 (12 Hrs.)

Peptidomimetics: Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.

REFERENCES

1 Medicinal Chemistry by Burger, Vol I –VI.

2 Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.

3 Comprehensive Medicinal Chemistry – Corwin and Hansch.

4 Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore

5 Introduction to Quantitative Drug Design by Y.C. Martin.

6 Principles of Medicinal Chemistry by William Foye, 7th Edition, Ippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.

7 Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh

8 Principles of Drug Design by Smith.

9 The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, II Edition, Elsevier Publishers, New Delhi

10 An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA

11 Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B. Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi.

12 Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

MPC 104 T: CHEMISTRY OF NATURAL PRODUCTS

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 104 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 104 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

The subject is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

.**Objectives**

At completion of this course it is expected that students will be able to understand-

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

Unit 1 (12 Hrs.)

Study of Natural products as leads for new pharmaceuticals for the following class of drugs

a) Drugs Affecting the Central Nervous System: Morphine Alkaloids

b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide

c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol

d) Neuromuscular Blocking Drugs: Curare alkaloids

e) Anti-malarial drugs and Analogues

f) Chemistry of macrolide antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem)

Unit 2 (12 Hrs.)

Alkaloids: General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.

Flavonoids : Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.

Steroids: General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents, male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive

agents and steroids (Vit.-D).

Unit 3 (12 Hrs.)

a. Terpenoids : Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di(retinol, Phytol, taxol) and tri terpenoids (Squalene,Ginsenoside)

carotinoids (β carotene).

b. Vitamins : Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.

Unit 4 (12 Hrs.)

a. Recombinant DNA technology and drug discovery rDNA technology, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation.

b. Active constituent of certain crude drugs used in Indigenous system Diabetic therapy-Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum; Liver dysfunction-Phyllanthus niruri; Antitumor-Curcuma longa Linn.

Unit 5 (12 Hrs.)

Structural Characterization of natural compounds : Structural characterization of natural compounds using IR, 1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalisglycosides.

REFERENCES

1 Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer-Verlag, Berlin, Heidelberg.
2 Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
3 Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles,Springer Science & Business Media
4 Chemistry of natural products Vol I onwards IWPAC
5 Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
6 Natural Product Chemistry "A laboratory guide" – Rapheal Khan.
7 The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
8 Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
9 Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
10 Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan.
11 Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
12 Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
13 Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.
14 Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition
15 Phytochemical methods of Harborne, Springer, Netherlands.
16 Burger's Medicinal Chemistry

MPC 105 P: PHARMACEUTICAL CHEMISTRY PRACTICAL I

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
MPC 105 P	**12**	**6**	**12**	**150**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 105 P	**20**	**30**	**6Hr**	**50**	**100**	**6Hrs**	**150**

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation.
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on Column chromatography
4. Experiments based on HPLC
5. Experiments based on Gas Chromatography
6. Estimation of riboflavin/quinine sulphate by fluorimetry
7. Estimation of sodium/potassium by flame photometry

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography
2. Claisen-schimidt reaction.
3. Benzyllic acid rearrangement.
4. Beckmann rearrangement.
5. Hoffmann rearrangement
6. Mannich reaction
7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8. Estimation of elements and functional groups in organic natural compounds
9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10. Some typical degradation reactions to be carried on selected plant constituents.

SEMINAR/ASSIGNMENTS

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
-	**7**	**4**	**7**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
-	-	-	-	-	-	-	100

M. PHARM. PHARMACEUTICAL CHEMISTRY (MPC)

SECOND SEMESTER

Table 1: Course of study

Course code	Course	Credit hours	Credit points	Hrs./week	Marks
MPC 201 T	Advanced Spectral Analysis	4	4	4	100
MPC 202 T	Advanced Organic Chemistry-II	4	4	4	100
MPC 203 T	Computer Aided Drug Design	4	4	4	100
MPC 204 T	Pharmaceutical Process Chemistry	4	4	4	100
MPC 205 P	Pharmaceutical Chemistry Practical II	12	6	12	150
	Seminar/Assignment	7	4	7	100
	Total	**35**	**26**	**35**	**650**

Table 2: Scheme for Internal Assessments and end semester examinations

Course code	Course	Internal Assessment				End semester exams		Total Marks
		Continuous mode	Sessional Exams.		Total	Marks	Duration	
			Marks	Duration				
MPC 201 T	Advanced Spectral Analysis	10	15	1 Hr	25	75	3Hrs	100
MPC 202 T	Advanced Organic Chemistry-II	10	15	1 Hr	25	75	3Hrs	100
MPC 203 T	Computer Aided Drug Design	10	15	1 Hr	25	75	3Hrs	100
MPC 204 T	Pharmaceutical Process Chemistry	10	15	1 Hr	25	75	3Hrs	100
MPC 205 P	Pharmaceutical Chemistry Practical II	20	30	6 Hr	50	100	6Hrs	150
-	Seminar/Assignment	-	-	-	-	-		100
		Total						**650**

ADVANCED SPECTRAL ANALYSIS

(MPC 201T)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 201 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 201 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC etc.

Objectives

At completion of this course it is expected that students will be able to understand-

1. Interpretation of the NMR, Mass and IR spectra of various organic compounds
2. Theoretical and practical skills of the hyphenated instruments
3. Identification of organic compounds

Unit I (12 Hrs)

UV and IR spectroscopy: Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α,β-carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.

Unit II (12 Hrs)

NMR spectroscopy: 1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.

Unit III (12 Hrs)

Mass Spectroscopy :Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.

Unit IV (12 Hrs)

Chromatography: Principle, Instrumentation and Applications of the following :

a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CEMS

g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion- Exclusion Chromatography) k) Flash chromatography

Unit V (12 Hrs)

a). Thermalmethods of analysis Introduction, principle, instrumentation and application of DSC, DTA and TGA.

b). Raman Spectroscopy Introduction, Principle, Instrumentation and Applications.

c). Radio immuno assay

Biological standardization , bioassay, ELISA, Radioimmunoassay of digitalis and insulin.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.

3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.

4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.

5. Quantitative analysis of Pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.

6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.

7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

ADVANCED ORGANIC CHEMISTRY – II (MPC 202T)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 202 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 202 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall able to understand

1. The principles and applications of Green chemistry
2. The concept of peptide chemistry.
3. The various catalysts used in organic reactions
4. The concept of stereochemistry and asymmetric synthesis.

Unit I (12 Hrs)

Green Chemistry:

a. Introduction, principles of green chemistry

b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis

c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications

d. Continuous flow reactors: Working principle, advantages and synthetic applications.

Unit II (12 Hrs)

Chemistry of peptides

a. Coupling reactions in peptide synthesis

b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides

c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies

d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.

Unit III (12 Hrs)

Photochemical Reactions Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. Pericyclic reactions Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples

Unit IV (12 Hrs)

Catalysis:

a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages

b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.

c. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs

d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions

e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.

f. Phase transfer catalysis - theory and applications

Unit V (12 Hrs)

Stereochemistry & Asymmetric Synthesis

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.

2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston,NewYork.

3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.

4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.

5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)

6. Organic synthesis-the disconnection approach, S. Warren, Wily India

7. Principles of organic synthesis, ROCNorman and JMCoxan, Nelson thorns

8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.

9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar Narosa Publishers.

COMPUTER AIDED DRUG DESIGN

(MPC 203T)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 203 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duratio	
		Marks	Duration				
MPC 203 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.

Objectives

At completion of this course it is expected that students will be able to understand

1. Role of CADD in drug discovery
2. Different CADD techniques and their applications
3. Various strategies to design and develop new drug like molecules.
4. Working with molecular modeling softwares to design new drug molecules
5. The in silico virtual screening protocols

Unit I (12 Hrs)

Introduction to Computer Aided Drug Design (CADD) History, different techniques and applications. Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

Unit II (12 Hrs)

Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters.

Unit III (12 Hrs)

Molecular Modeling and Docking

a) Molecular and Quantum Mechanics in drug design.

b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation

c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

Unit IV (12 Hrs)

Molecular Properties and Drug Design

a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.

b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.

c) Homology modeling and generation of 3D-structure of protein.

Unit V (12 Hrs)

Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping.

In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

REFERENCES

1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.

2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group.

3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.

4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.

5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.

6. Medicinal Chemistry by Burger, Wiley Publishing Co.

7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.

8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams & Wilkins.

9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.

10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore

PHARMACEUTICAL PROCESS CHEMISTRY

(MPC 204T)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 204 T	**4**	**4**	**4**	**60**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 204 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Scope

Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production. The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Objectives

At completion of this course it is expected that students will be able to understand

1. The strategies of scale up process of apis and intermediates
2. The various unit operations and various reactions in process chemistry

Unit I (12 Hrs)

Process chemistry : Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large scale process. In-process control and validation of large scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic impurities.

Unit II (12 Hrs)

Unit operations

a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.

b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,

c) Distillation: azeotropic and steam distillation

d) Evaporation: Types of evaporators, factors affecting evaporation.

e) Crystallization: Crystallization from aqueous, nonaqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

Unit III (12 Hrs)

Unit Processes- I

a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,

b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process.

c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H2O2, sodium hypochlorite, Oxygen gas, ozonolysis.

Unit IV (12 Hrs)

Unit Processes - II

a) Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.

b) Fermentation: Aerobic and anaerobic fermentation. Production of

i. Antibiotics; Penicillin and Streptomycin,

ii. Vitamins: B2 and B12

iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis

i. Streamlining reaction steps, route selection,

ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

Unit V (12 Hrs)

Industrial Safety

a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)

b) Fire hazards, types of fire & fire extinguishers

c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO 14001(Environmental Management System), Effluents and its management

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever- Changing Climate-An Overview; K. Gadamasetti, CRC Press.

2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.

3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.

4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill

5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999)

6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis

7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis Rethinking the Routes to Scale-Up

8. P.H.Groggins: Unit processes in organic synthesis (MGH)

9. F.A.Henglein: Chemical Technology (Pergamon)

10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press

11. Clausen,Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,

12. Lowenheim & M.K. Moran: Industrial Chemicals

13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House

14. J.K. Stille: Industrial Organic Chemistry (PH)

15. Shreve: Chemical Process, Mc Grawhill.

16. B.K.Sharma: Industrial Chemistry, Goel Publishing House

17. ICH Guidelines

18. United States Food and Drug Administration official website www.fda.gov

PHARMACEUTICAL CHEMISTRY PRACTICALS – II

(MPC 205P)

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
MPC 205 P	**12**	**6**	**12**	**150**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 205 P	**20**	**30**	**6Hr**	**50**	**100**	**6Hrs**	**150**

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)

a) Oxidation

b) Reduction/hydrogenation

c) Nitration

2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)

3. Assignments on regulatory requirements in API (2 experiments)

4. Comparison of absorption spectra by UV and Wood ward – Fieser rule

5. Interpretation of organic compounds by FT-IR

6. Interpretation of organic compounds by NMR

7. Interpretation of organic compounds by MS

8. Determination of purity by DSC in pharmaceuticals

9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra

10. To carry out the preparation of following organic compounds

11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).

12. Preparation of 4-iodotolene from p-toluidine.

13. NaBH4 reduction of vanillin to vanillyl alcohol

14. Preparation of umbelliferone by Pechhman reaction

15. Preparation of triphenyl imidazole

16. To perform the Microwave irradiated reactions of synthetic importance (Any two)

17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares

18. Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modeling

19. 2D-QSAR based experiments

20. 3D-QSAR based experiments

21. Docking study based experiment

22. Virtual screening based experiment

SEMINAR/ASSIGNMENTS

Course of study

Course code	Credit hours	Credit points	Hrs./week	Marks
-	**7**	**4**	**7**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
-	-	-	-	-	-	-	100

M. PHARM.-PHARMACEUTICAL CHEMISTRY (MPC)

. THIRD SEMESTER

Table 1 : Course of study

Course code	Course	Credit hours	Credit points
MRM 301 T	Research Methodology and Biostatistics*	4	4
-	Journal Club	1	1
-	Research Work	28	14
-	Discussion/Presentation (Proposal Presentation)	2	2
	Total	**35**	**21**

* Non-University Examination

Table 2 : Scheme for Internal Assessments and end semester examinations

Course code	Course	Internal Assessment				End semester exams		Total Marks
		Continuous mode	Sessional Exams.		Total	Marks	Duration	
			Marks	Duration				
MRM 301T	Research Methodology and Biostatistics*	10	15	1 Hr	25	75	3Hrs	100
-	Journal Club	-	-	-	25	-	-	25
-	Research Work	-	-		50	350	1Hr	350
-	Discussion/Presentation (Proposal Presentation)	-			50	-	-	50
		Total						**525**

* Non-University Examination

MPC 301 T: Research Methodology & Biostatistics

Course of study

Course code	Credit hours	Credit points	Hrs./week	Teaching Hrs/semester	Marks
MPC 301 T	**4**	**4**	**4**	**-**	**100**

Scheme for Internal Assessments and end semester examinations

Course code	Internal Assessment				End semester exams		Total Marks
	Continuous mode	Sessional Exams.		Total	Marks	Duration	
		Marks	Duration				
MPC 301 T	**10**	**15**	**1 Hr**	**25**	**75**	**3Hrs**	**100**

Unit 1

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

Unit 2

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests(students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

Unit 3

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality

Unit 4

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals

Unit 5

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

M. PHARM. PHARMACEUTICAL CHEMISTRY (MPC)

FOURTH SEMESTER

Table 1 : Course of study

Course code	Course	Credit hours	Credit points
-	Journal Club	1	1
-	Research Work	31	16
-	Discussion/ Final Presentation	3	3
	Total	**35**	**20**

Table 2 : Scheme for Internal Assessments and end semester examinations

SEMESTER IV

Course code	Course	Internal Assessment				End semester exams		Total Marks
		Continuous mode	Sessional Exams.		Total	Marks	Duration	
			Marks	Duration				
-	Journal Club	-	-	-	25	-	-	25
-	Research Work and Colloquium	-	-		-	400	1Hr	400
-	Discussion/ Final Presentation	-			75	-	-	75
-		**Total**						**500**

DEVI AHILYA
VISHWAVIDYALAYA, INDORE

SCHOOL OF PHARMACY

Ph.D. Course work Syllabus

August 2017

DEVI AHILYA VISHWAVIDYALAYA, INDORE
SCHOOL OF PHARMACY
SYLLABUS: Ph.D. COURSE WORK (PHARMACY)

Course	Title	Credits
Course-I	Research Methodology	4
Course-II	Research Methodology in Pharmacy	3
Course-III	Computer Application	3
Course-IV	Review of Literature	3
	Comprehensive Viva-voce	3
	Total Credits	16

Course –I: Research Methodology

Objective: To gain knowledge in general about research, its methodologies and common tools and techniques adopted for pursuing research.	
Unit-I	Introduction to research, formal science and empirical science, scientific research, research types, research design process, errors in research, formulation of research problem.
Unit-II	Hypothesis, hypothesis generation, null and alternate hypothesis, hypothesis testing, data collection; Primary and secondary data, measurement of scales; nominal, ordinal, ratio, interval and sampling.
Unit-III	Introduction, nature and purpose of research ethics, ethical norms, research misconduct, conflict of interest, plagiarism.
Unit-IV	Measures of central tendency and dispersion, probability distribution, test of significance, parametric test and non parametric test (F-test, t-test, chi-square test, sign test, Wilcoxon signed rank test, Spearman rank correlation), analysis of variance, correlation and regression.
Unit-V	Research paper and thesis writing steps and process. Research paper presentation-oral and poster.

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Course –II: Research Methodology in Pharmacy

Objective: To gain knowledge and practical experience about various methodologies commonly employed in research filed of pharmacy.	
Unit-I	Development and validation of analytical methods based on UV, HPLC and HPTLC.
Unit-II	Introduction of systematic approaches for isolation, identification, and structure elucidation of unknown impurities. Synthesis, purification, standardization, and quantification of impurities of active drug substances. Designing and optimization of different routes for synthesis of impurities. Case studies for impurity identification and structure elucidation.
Unit-III	Principle, instrumentation, working and application of Differential scanning calorimetry, Transmission electron microscopy, Scanning electron microscopy.
Unit-IV	Purification of solvents and compounds. Extraction and isolation of phytoconstituents.
Unit-V	Animals used in research, limitations of animal tests, CPCSEA guidelines for performing experiments on animals, anaesthetics used in laboratory animals, anatomical specifications, advantage and limitations of various anatomical sites of blood collection in laboratory animals, maintenance and breeding of laboratory animals, protocol development for animal experimentation, transgenic animals.

Course –III: Computer Application

Objective : To gain knowledge and practical experience about the use of various computer software and statistical tools for application in research work.	
Unit-I	MS word: Features and applications related to presentations of text in suitable format and saving the data for future applications.
Unit-II	Ms-Excel: Design and application of formulae for calculation and their applications to the experimental data. Use of statistical tools in preparation of graphs, histograms, charts and diagrams.
Unit-III	MS Power Point: Preparation of power point presentations based on topic of research. Insertion of figures, graphs, charts in presentation. Preparation of scientific posters for presentation. Use of various presentation techniques.

02/8/17 Radha 2/8/17 02.08.17

Unit-IV	Use of SPSS and Internet applications: Methods of preparation of data sheet and entering the data according to its characteristics. Use of various statistical tools on SPSS. Exploring various websites and search engines for collecting quality literature and secondary data related to research work.
Unit-V	Bio-informatics: Meaning and relation with molecular biology. Bioinformatics tools-FASTA, BLAST, RASMOL, databases (GENBANK, Pubmed, PDB) and software (RASMOL, Ligand Explorer). Introduction to sequence and alignments, local alignments and global alignments, phylogenetic analysis.

Course –IV: Review of Literature

Objective : To collect the available literature in the chosen field of research, preparation of chronological order about the development of various sub topics in the field, identification of gaps in the knowledge and preparation of objectives to bridge the gaps.

Sources of research material, literature survey, compiling records.

Kinds of scientific documents-research paper, review paper, book review, thesis and conference and project reports.

Components of a research paper-IMRAD system, title, author and addresses, abstracts.

Dealing with publishers-submission of manuscripts and ordering reprints.

Oral and poster presentation of research papers in conference/symposia.

Preparation and submission of research projects proposal to funding agencies.

To develop communication skills for presentation of research findings.

To understand and follow ethical issues in research.

Respective supervisors will evaluate literature reviews submitted by the student and recommend the topic for registration. The supervisor will also help in developing communication skill and address ethical issues in research.

Comprehensive viva-voce: As per the provision of ordinance-31, a student will appear for comprehensive viva-voce.

02/8/17 2/8/17 02.08.17