

**The Indian Pharmaceutical Association-Maharashtra State Branch's
Bombay College of Pharmacy-Autonomous**

Kalina, Santacruz (E) Mumbai 400098

(Approved by AICTE, PCI and affiliated to University of Mumbai)

Accredited by NBA

**Detailed Syllabus structure and Syllabus for the
First year and Second year B.Pharm
Choice Based Credit System (CBCS)**

Effective for F.Y.B.Pharm from Academic Year 2019-2020

and

S. Y. B.Pharm from Academic Year 2020-2021

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	4	-	1
BP112RBP	Remedial Biology – Practical	4	-	1
Total		34/36^{\$}/40[#]	4	27/29^{\$}/30[#]

[#]Applicable ONLY for the students who have studied Mathematics/Physics/Chemistry at HSC and will be appearing for the Remedial Biology (RB) course.

^{\$}Applicable ONLY for the students who have studied Physics/Chemistry/Botany/Zoology at HSC and will be appearing for the Remedial Mathematics (RM) course.

Table-II: 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

Table-III: 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
BP 308P	Pharmaceutical Engineering –Practical	4	-	2
Total		28	4	24

Table-IV: 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

SEMESTER I

BP101T

HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)

45 Hours

Course Objectives:

To impart fundamental knowledge on the anatomy, physiology, and functions of the various systems of the human body.

Course Outcomes:

The learner should be able to:

1. Explain the gross morphology, structure, and functions of various organs of the human body with respect to the levels of organisation and communication
2. Explain the various homeostatic mechanisms and their imbalances of the lymphatic, nervous and cardiovascular systems in relation to the knowledge of the pathophysiology of diseases.
3. Discuss the composition and functions of blood, explain the process of haemostasis and correlate the knowledge to haematological disorders.
4. Understand coordinated working pattern of different muscles and organs of each system.

Unit	Details	Hours
1	Introduction to human body <ul style="list-style-type: none"> • Definition and scope of anatomy and physiology • Levels of structural organization and body systems • Basic life processes, homeostasis 	1
2	Cellular level of organization <ul style="list-style-type: none"> • Structure and functions of cell • Transport across cell membrane, cell division, cell junctions • General principles of cell communication: intracellular signaling pathway activation extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent by b) Paracrine c) Synaptic d) Endocrine 	2
3	Tissue level of organization <ul style="list-style-type: none"> • Structural and functional characteristics of following tissues: Epithelial, Connective, Nervous, Muscle 	2
4	Integumentary system <ul style="list-style-type: none"> • Structure and functions of skin 	2
5	Skeletal system and Joints <ul style="list-style-type: none"> • Divisions of skeletal system • Types of bone, salient features, and functions of bones • Organization of skeletal muscle • Physiology of muscle contraction, neuromuscular junction • Structural and functional classification of joints • Types of joints movements and its articulation 	8
6	Body fluids and blood <ul style="list-style-type: none"> • Body fluids 	6

	<ul style="list-style-type: none"> Composition and functions of blood Hemopoiesis, formation of haemoglobin, anaemia Mechanisms of coagulation Blood grouping, Rh factors, transfusion, its significance Leucopoiesis Immunity: Basics and types Disorders of blood, reticuloendothelial system 	
7	Lymphatic system <ul style="list-style-type: none"> Components and functions of lymphatic system Lymphatic organs and tissues Organization of lymph vessels Formation and flow of lymph Functions of lymphatic system 	3
8	Peripheral Nervous System <ul style="list-style-type: none"> Classification of peripheral nervous system Structure and functions of sympathetic and parasympathetic nervous system Origin and functions of spinal and cranial nerves Methods to measure electrical activity of brain 	9
9	Structure and Function of following sensory organs and their disorders: <ul style="list-style-type: none"> Eye Ear Tongue Nose 	5
10	Cardiovascular system <ul style="list-style-type: none"> Functional anatomy of heart Conducting system of heart, Cardiac cycle, Electrocardiogram (ECG) Physiology of blood circulation, Functional anatomy of blood vessels Blood pressure and factors regulating blood pressure, baroreceptors, chemoreceptors, vasomotor centre, humoral and neuronal control of blood pressure and circulation disorders of heart. 	7
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Waugh A, and Grant A, Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
2. Tortora G. J. & Derrickson B, Principles of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey, 2016
3. Guyton A. C., Hall J. E., Textbook of Medical Physiology, 12th edition, W. B. Saunders Company, USA/Prism Books Ltd. India, 2010.
4. Mackenna B. R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.

5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
6. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
7. Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
8. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017.

BP102T

PHARMACEUTICAL ANALYSIS (Theory)

45 Hours

Course Objectives:

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

Course Outcomes:

Upon completion of the course student shall be able to -

- Understand the principles of volumetric and electro chemical analysis
- Carryout various volumetric and electrochemical titrations
- Perform experiments involving these principles of analysis

Unit	Details	Hours
1	<p>(a) Pharmaceutical analysis- Definition and scope</p> <p>i) Different techniques of analysis (Instrumental and Non-Instrumental)</p> <p>ii) Methods of expressing concentration - Molarity, Molality, percent concentration, ppm, ppb, Normality, Numericals</p> <p>iii) Primary and secondary standards</p> <p>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</p> <p>(b) Errors: Sources of errors, types of errors, methods of minimizing errors, accuracy, precision, Concepts and numerical of Mean, Median, Standard deviation, Relative standard deviation and Significant figures</p> <p>(c) Pharmacopoeia – Introduction to Pharmacopoeial monographs and their significance (relevance of all the tests to be discussed), Sources of impurities in medicinal agents, limit tests</p>	10
2	<p>(a) Titrations (Theoretical terms) - Titrimetric analysis, Titrant, Titrand, Theoretical end point or equivalence point, End point of titration, Titration error, Conditions for titrimetric analysis, Classification of reactions for titrimetric analysis</p> <p>(b) Law of Mass Action, Equilibrium Constant, pH, pKa, pKb, hydrolysis of salts, Buffer solutions, Buffer Capacity, Numericals for pH calculation</p> <p>(c) Acid base titration: Theories of acid base indicators (Ostwald's theory, Resonance theory), Mixed indicators, concept of range of indicators, Choice</p>	10

	<p>of indicators; Classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, Neutralization curves; Methods of titration (Direct titration, back titration, blank determination, Factor calculation for assays); Assay of benzoic acid</p> <p>(d) Non aqueous titration: Solvents (aprotic, protophilic, protogenic, amphiprotic), characteristics of solvents for non-aqueous titrations (acid-base character, dielectric constant, leveling and differentiating effect), Indicators for non-aqueous titrations, Acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl</p>	
3	<p>(a) Precipitation titrations: Common Ion Effect, Solubility Product, Factors affecting solubility of precipitates, Fractional precipitation; Mohr's method, Volhard's, Modified Volhard's, Fajans method, Standardization of silver nitrate, Estimation of sodium chloride</p> <p>(b) Complexometric titration: Terms - Complex, Complexing agents (Complexones), Chelate, Ligand, Co-ordination number, Chelating agent, Sequestering agent, Metal-ligand complex; Formations of complexes; Classification (Direct method, back titration, replacement titration), Metal ion indicators (pM indicators), masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate, Determination of mixture of lead, zinc and magnesium in a sample</p> <p>(c) Gravimetry: Principle and steps involved in gravimetric analysis, Organic and inorganic precipitants, Purity of the precipitate: co-precipitation and post precipitation, Ostwald's ripening, Degree of supersaturation (Von Weimarn ratio), Estimation of barium sulphate, Assay of Aluminium by oxine reagent</p> <p>(d) Nitrite titrations: Basic Principles, methods and application of diazotisation titration, Concept of external indicator, Assay of Sulphacetamide sodium</p>	10
4	<p>(a) Redox titrations</p> <p>i) Concepts of oxidation and reduction - Oxidising and reducing agents, Standard reduction potential, Nernst equation, Redox titration curve and Equivalence point</p> <p>ii) Types of redox titrations (Principle, Titrants, Indicators and Application) – Permanganometry (Assay of hydrogen peroxide), Cerimetry (Assay of Paracetamol and Dried Ferrous sulphate), Iodimetry (Assay of Ascorbic acid API), Iodometry (Assay of potassium permanganate), Bromatometry (Assay of Isoniazid), Dichrometry (Iron), Titration with potassium iodate (Assay of Potassium iodide)</p>	8
5	<p>(a) Electrochemical methods of analysis</p> <p>i) Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.</p> <p>ii) 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 (aqueous acid-base titrations -Strong acid vs strong base, strong acid vs</p>	7

	weak base, weak acid vs strong base, weak acid vs weak base) and applications. iii) Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, Current-Voltage curve (Polarogram), supporting electrolyte, Oxygen wave, polarographic maxima, factors affecting limiting current, half wave potential, applications, Pulse polarography-Normal pulse polarography, Differential pulse polarography and square wave polarography	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Beckett, A. H. And J. B. Stenlake. Practical Pharmaceutical Chemistry: Part I and II, CBS Publishers and Distributors, India.
2. Christian, G. D. Analytical Chemistry, Wiley India Pvt. Limited.
3. Connors, K. A., A Textbook of Pharmaceutical Analysis, John Wiley and Sons, Canada.
4. Skoog, D. A., F. J. Holler and S. R. Crouch. Principles of Instrumental Analysis, Saunders College Publishing, USA.
5. Skoog, D. A., and D. M. West. Fundamentals of Analytical Chemistry, Saunders College Publishing, USA.
6. Watson, D. G. Pharmaceutical Analysis: A Textbook for Pharmacy Students and Pharmaceutical Chemists, Elsevier Health Sciences, London.
7. Mendham J, R. C. Denny, J.D. Barnes, M. Thomas. Vogel's Textbook of Quantitative Chemical Analysis, Pearson Education.
8. Kar, A. Pharmaceutical Drug Analysis, New Age International India.
9. Mahajan S. S. Instrumental Methods of Analysis, Popular Prakashan Pvt Ltd, India.
10. Chatwal, G. R., and M. Arora. Analytical Chemistry, Himalaya Publishing House.
11. Indian Pharmacopoeia, Indian Pharmacopoeia Commission, India.
12. Willard, H. H., L. Merritt, F. Settle and J. A. Dean. Instrumental Methods of Analysis, CBS Publishers & Distributors, India.
13. Ewing, G. W. Instrumental Methods of Chemical Analysis, Mcgraw-Hill Book Company New York.
14. Robinson, J. W., E. M. S. Frame and G. M. Frame. Undergraduate Instrumental Analysis, Skelly Frame and G.M. Frame II, Publication.
15. Kellner, R., J. M. Mermet, M. Otto, M. Valcárcel and H. M. Widmer. Analytical Chemistry, John Wiley & Sons Australia, Limited.

BP103T

PHARMACEUTICS - I (Theory)

45 Hours

Course Objectives:

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

Course Outcomes:

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

1. Know the history of profession of pharmacy and official compendia
2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. Understand the professional way of handling the prescription and dispensing of medications
4. Describe formulation and evaluation aspect of monophasic liquid formulations
5. Understand the dispensing aspects of dosage forms like powders, monophasic liquids, biphasic systems suppositories and semisolids

Unit	Details	Hours
1	<p>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.</p> <p>Dosage forms: Introduction to dosage forms, classification, and definitions</p> <p>Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.</p> <p>Posology: Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.</p>	10
2	<p>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.</p> <p>Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent, and hygroscopic powders, eutectic mixtures. Geometric dilutions.</p> <p>Liquid dosage forms: Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques</p>	10
3	<p>Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.</p> <p>Biphasic liquids:</p> <p>Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.</p> <p>Emulsions: Definition, classification, emulsifying agents, tests for identification of type of Emulsion, Methods of preparation, stability problems and methods to overcome</p>	9
4	<p>Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.</p> <p>Pharmaceutical incompatibilities: Definition, classification, physical, chemical, and therapeutic incompatibilities with examples.</p>	9
5	<p>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</p>	7

	semi solid dosages forms	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Walkins, USA, 2014.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, 12th edition, CBS Publishers and Distributors, New Delhi, 2008.
3. Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.
4. Indian Pharmacopoeia.
5. British Pharmacopoeia.
6. Lachman, L., Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, 1986
7. Khar, R.K., Vyas, S.P., Ahmad F.J., Jain G.K., Lieberman, Lachman's - The Theory and Practice of Industrial Pharmacy, 4th edition, CBS Publishers and Distributors, New Delhi, 2020.
8. Gennaro A.R., Remington : The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, Philadelphia, 2005.
8. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publishers and Distributors Pvt. Ltd, Delhi, 2005.
9. Rawlins E.A., Bentley's Textbook of Pharmaceutics, 8th edition, Elsevier India, 2010.
10. Ghebre-Sellassie I., Pharmaceutical Pelletization Technology, 1st edition, Marcel Dekker, Inc., New York, 1990
11. Parikh D.M., Handbook of Pharmaceutical Granulation Technology, 1st edition, Marcel Dekker, Inc., New York, 1997.
12. Nieloud F and Gilberte M., Pharmaceutical Emulsions and Suspensions, 1st edition, Marcel Dekker, Inc., New York, 2000.

BP104T

PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)

45 Hours

Course Objectives:

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

Course Outcomes:

Upon completion of the course the 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

Unit	Details	Hours
1	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	10
2	Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions,	10

	<p>measurements of tonicity, calculations, and methods of adjusting isotonicity.</p> <p>1. 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.</p> <p>2. Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.</p>	
3	<p>Gastrointestinal agents</p> <p>Acidifiers: Ammonium chloride* and dil. HCl</p> <p>Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture.</p> <p>Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite</p> <p>Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations</p>	10
4	<p>Miscellaneous compounds</p> <p>Expectorants: Potassium iodide, Ammonium chloride*.</p> <p>Emetics: Copper sulphate*, Sodium potassium tartarate</p> <p>Haematinics: Ferrous sulphate*, Ferrous gluconate</p> <p>Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite</p> <p>Astringents: Zinc Sulphate, Potash Alum</p>	8
5	<p>Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α, β, γ radiations, Half-life, radio isotopes and study of radio isotopes - Sodium iodide I^{131}, Storage conditions, precautions & pharmaceutical application of radioactive substances.</p>	7
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Beckett A. H., Stenlake J. B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013
4. Bentley AO, Atherden LM, Driver JE, Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York and Toronto, 1945
5. Kennedy J. H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, 1990
6. Indian Pharmacopoeia

BP105T

COMMUNICATION SKILLS (Theory)

30 Hours

Course Objectives:

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.

Course Outcomes:

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. Effectively manage the team as a team player
4. Develop interview skills
5. Develop Leadership qualities and essentials

Unit	Details	Hours
1	Communication Skills: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context 1. Barriers to communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers 2. Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment	7
2	1. Elements of Communication: Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	7
3	Basic Listening Skills: Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations 1. 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 2. Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	7
4	Interview Skills: Purpose of an interview, Do's and Don'ts of an interview 1. Giving Presentations: Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	5
5	Group Discussion: Introduction, Communication skills in group discussion, Do's and Don'ts of group discussion	4
	TOTAL	30

Reference Books (Latest Editions to be adopted):

1. Ruther Foord A.J., Basic Communication Skills for Technology, 2nd Edition, Pearson Education, Delhi, 2011
2. Sanjay Kumar, Pushp lata, Communication skills, 2nd Edition, Oxford Press, Lucknow 2015.
3. Robbins S.P., Organizational Behaviour, 1st Edition, Pearson, San Diego, USA, 2013.
4. Hasson G., Brilliant- Communication skills, 1st Edition, Pearson Life, UK, 2011
5. Gopala S.W., The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson Education, Delhi, 2013.

6. Dalley D, Burton Lois, Greenhall M., Developing your influencing skills, 1st Edition Universe of Learning Ltd, Manchester, United Kingdom, 2010.
7. Konar N., Communication skills for Professionals, 2nd Edition, New arrivals –PHI Learning Pvt. Ltd, New Delhi, 2011.
8. Mitra, B.K., Personality development and soft skills, 1st Edition, Oxford Press, Lucknow, 2011.
9. Butter Field, J., Soft skill for everyone, 1st Edition, Cengage Learning India Pvt. Ltd, New Delhi, 2011.
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, New York, 2011.
11. Adair John, Effective communication, 4th Edition, Pan Mac Millan, 2009.
12. Daniels A.C, Bringing out the best in people, 2nd Edition, Mc Graw Hill Education, New York, 1999.

BP106RBT

Remedial Biology (Theory)

30 Hours

Course Objectives:

To get the learner acquainted with the facets of biology in the plant and animal kingdom.

Course Outcomes:

The learner should be able to:

1. Understand the classification and features of plant and animal kingdom.
2. Know the anatomy and physiology of plants.
3. Appreciate the anatomy & physiology in animals especially the human body

Unit	Details	Hours
1	Living world: <ul style="list-style-type: none"> Definition and characters of living organism Diversity in the living world Binomial nomenclature Five kingdoms of life and basis of classification. Salient features of Monera, Protista, Fungi, Animalia and Plantae, Virus 	5
2	Morphology of Flowering plants <ul style="list-style-type: none"> Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed General Anatomy of root, stem, leaf of monocotyledons & dicotyledones 	2
3	Body fluids and circulation <ul style="list-style-type: none"> Composition of blood, blood groups, coagulation of blood Composition and functions of lymph Human circulatory system <ul style="list-style-type: none"> Structure of human heart and blood vessels Cardiac cycle, cardiac output, and ECG Digestion and Absorption <ul style="list-style-type: none"> Human alimentary canal and digestive glands Role of digestive enzymes 	7

	<ul style="list-style-type: none"> Digestion, absorption, and assimilation of digested food <p>Breathing and respiration</p> <ul style="list-style-type: none"> Human respiratory system Mechanism of breathing and its regulation Exchange of gases, transport of gases and regulation of respiration Respiratory volumes 	
4	<p>Excretory products and their elimination</p> <ul style="list-style-type: none"> Modes of excretion Human excretory system- structure and function Urine formation Rennin angiotensin system Neural control and coordination <p>Definition and classification of nervous system</p> <ul style="list-style-type: none"> Structure of a neuron Generation and conduction of nerve impulse Structure of brain and spinal cord Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata <p>Chemical coordination and regulation</p> <p>Endocrine glands and their secretions</p> <ul style="list-style-type: none"> Functions of hormones secreted by endocrine glands <p>Human reproduction</p> <ul style="list-style-type: none"> Parts of female reproductive system Parts of male reproductive system Spermatogenesis and Oogenesis Menstrual cycle 	7
5	<p>Plants and mineral nutrition</p> <ul style="list-style-type: none"> Essential mineral, macro, and micronutrients Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation <p>Photosynthesis</p> <ul style="list-style-type: none"> Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis 	5
6	<p>Plant respiration</p> <ul style="list-style-type: none"> Respiration, glycolysis, fermentation (anaerobic) <p>Plant growth and development</p> <ul style="list-style-type: none"> Phases and rate of plant growth, condition of growth, introduction to plant growth regulators <p>Cell: The unit of life</p> <ul style="list-style-type: none"> Structure and functions of cell and cell organelle, cell division <p>Tissues</p> <ul style="list-style-type: none"> Definition, types of tissues, location, and functions. 	4
	TOTAL	30

Textbooks and Reference books (Latest Editions to be adopted):

1. Gokhale S.B, Kalaskar M.G, Kulkarni Y.A, Remedial Biology (Pharmaceutical Biology), 1st edition, Nirali Prakashan, Pune, 2017.
2. Seetharam P.L, Thulajappa Y, Chavan R.R, Textbook of Biology, 1st edition, Expert Educational Publishers, Bangalore, 1995.
3. Naidu B.V.S, Renukumar B.M, Textbook of Biology, 1st edition, Sri Renuka Publications, Davangere, 1972.
4. Naidu B.V.S, Murthy P.K, Textbook of Biology, 1st edition, Prakash Sahithye, Bangalore, 1972.
5. Dutta A.C, Botany for Degree students, 6th edition, MKM Publishers Pvt. Ltd, New Delhi, 1998.
6. Ayyar E.M; T N Ananthakrishnan, A Manual of Zoology, 5th edition, S. Viswanathan Pvt. Ltd, Madras, 1992.
7. Gokhale S.B, Kalaskar M.G, Kulkarni Y.A, A Practical book of Remedial Biology, 1st edition, Nirali Prakashan, Pune, 2018.

BP106RMT

REMEDIAL MATHEMATICS (Theory)

30 Hours

Course Objectives:

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.

Course Outcomes:

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

Unit	Details	Hours
1	<p>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</p> <p>1. Logarithms Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems.</p> <p>2. Function: Real Valued function, Classification of real valued functions,</p> <p>3. Limits and continuity: Introduction, Limit of a function, Definition of limit of a function (ϵ - δ definition),</p> $\lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = na^{n-1}, \quad \lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1,$	6
2	<p>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</p>	6

	system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations	
3	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 x^n w.r.t x , where n is any rational number, Derivative of e^x , Derivative of $\log_e x$, Derivative of a^x , 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	6
4	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	6
5	Differential Equations: Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, Application in solving Pharmacokinetic equations 1. 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	6
	TOTAL	30

Reference Books (Latest Editions to be adopted):

1. Shanti Narayan, Mittal P.K, Differential Calculus, revised edition, S. Chand and Co. Pvt. Ltd, New Delhi, 2013.
2. Panchaksharappa Gowda D. H, Pharmaceutical Mathematics with application to Pharmacy, 1st Edition, PharmaMed Press, 2014
3. Shanti Narayan, Mittal P.K, Integral Calculus, 11th edition, S. Chand and Co. Pvt. Ltd, 2013.
4. Grewal B. S, Higher Engineering Mathematics, 44th edition, Khanna Publishers, New Delhi, 2020.

BP107P

Human Anatomy and Physiology (Practical)

Course Objectives:

To get the learner acquainted with the diagnostic methods employed in detection of the pathology of some disease states

Course Outcomes

The learner should be able to:

1. Perform haematology tests, record the heart rate, pulse and blood pressure and relate the results with clinical conditions.
2. Identify and postulate the position of the bones in human skeleton.
3. Identify and describe the various body tissues and organs based on the structure and organisation of cells.

Unit	Details
1	Study of compound microscope.
2	Microscopic study of permanent slides of tissues: Discussion on the normal as well as pathological changes with the help of charts / images <ul style="list-style-type: none"> • Columnar, Cuboidal, Squamous, Ciliated Epithelium • Cardiac, Skeletal, Smooth muscle • Ovary, Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein
3	Study of bones: <ul style="list-style-type: none"> • Axial • Appendicular
4	Introduction to hemocytometry: Determination of the hematology studies and discussion of the pathological deviations from baseline values <ol style="list-style-type: none"> 1) Red Blood cell (RBC) Count 2) Total Leukocyte Count 3) Differential Leukocyte (WBC) Count 4) Haemoglobin content of blood 5) Bleeding / Clotting Time 6) Blood groups 7) Erythrocyte Sedimentation Rate (ESR) / Hematocrit (Demonstration)
5	Determination of heart rate and pulse rate.
6	Recording of blood pressure.

Reference Books (Latest Editions to be adopted):

1. Mackenna B. R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
2. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
3. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
4. Ghai C. L., Textbook of Practical Physiology, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi
5. Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
6. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017

Course Objectives:

This course deals with the fundamentals of analytical chemistry and principles of titrimetry, turbidometry, electrochemical analysis and gravimetry

Course Outcomes:

Upon completion of the course student shall be able to -

- Understand the principles of volumetric, turbidometric, electrochemical and gravimetric analysis
- Carryout various these analysis
- Develop skills to analyse the data obtained and make conclusions.

I Preparation and standardization of -

- (1) Sodium hydroxide
- (2) Sulphuric acid
- (3) Sodium thiosulfate
- (4) Potassium permanganate
- (5) Ceric ammonium sulphate

II 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 / Sodium metabisulphite
- (4) Calcium gluconate by complexometry
- (5) Hydrogen peroxide by permanganometry
- (6) Sodium benzoate by non-aqueous titration
- (7) Sodium Chloride by precipitation titration
- (8) Assay of Aspirin (Back titration)
- (9) Assay of Sulphacetamide sodium (Nitrite titration)
- (10) Assay of Ascorbic acid (Iodimetry)

III 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
- (4) Potentiometric titration of weak acid against strong base

IV Gravimetric analysis

- (1) Determination of Barium as Barium sulphate

Reference Books (Latest Editions to be adopted):

1. Beckett A. H., Stenlake J. B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013
4. Bentley AO, Atherden LM, Driver JE, Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York and Toronto, 1945
5. Kennedy J. H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, 1990

6. Indian Pharmacopoeia
7. Christian, G. D., Dasgupta, P.K., Schug, K.A., Analytical Chemistry, 7th edition, Wiley India Pvt. Limited, 2013.
8. Mendham J, Denny R. C., Barnes J.D., Thomas M, Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Pearson Education, New Delhi, 2009.

BP109P
PHARMACEUTICS - I (Practical)

Course Objectives:

This course is designed to impart a fundamental knowledge for preparing selected conventional dosage forms.

Course Outcomes:

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

1. Understand the basics of different dosage forms, pharmaceutical incompatibilities, and pharmaceutical calculations
2. Prepare some simple and conventional dosage forms

Unit	Details
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
4	Solutions b) Iodine Throat Paint (Mandles Paint) 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) Aluminum 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 gelatin suppository b) Coca butter suppository c) Zinc Oxide suppository
9	Semisolids a) Sulphur ointment

	b) Non staining-iodine ointment with methyl salicylate c) Carbopol gel
10	Gargles and Mouthwashes a) Iodine gargle b) Chlorhexidine mouthwash

Reference Books (Latest Editions to be adopted):

1. Ansel H.C., Allen L.V., Pharmaceutical Dosage Forms and Drug Delivery Systems, 10th edition, Lippincott Williams and Walkins, USA, 2014.
2. Carter S.J., Cooper and Gunn's-Dispensing for Pharmaceutical Students, 12th edition, CBS Publishers and Distributors, New Delhi, 2008.
3. Taylor, K., Aulton M.E., Pharmaceutics: The Science of Dosage Form Design, 2nd edition, Churchill Livingstone, Edinburgh, 2001.
4. Indian Pharmacopoeia.
5. British Pharmacopoeia.
6. Lachman, L., Lieberman H.A., Kanig, J.L., The Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, 1986
7. Khar, R.K., Vyas, S.P., Ahmad F.J., Jain G.K., Lieberman, Lachman's - The Theory and Practice of Industrial Pharmacy, 4th edition, CBS Publishers and Distributors, New Delhi, 2020.
8. Gennaro A.R., Remington : The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins, Philadelphia, 2005.
9. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publishers and Distributors Pvt. Ltd, Delhi, 2005.
10. Rawlins E.A., Bentley's Textbook of Pharmaceutics, 8th edition, Elsevier India, 2010.
11. Ghebre-Sellassie I., Pharmaceutical Pelletization Technology, 1st edition, Marcel Dekker, Inc., New York, 1990
12. Parikh D.M., Handbook of Pharmaceutical Granulation Technology, 1st edition, Marcel Dekker, Inc., New York, 1997.
13. Nieloud F and Gilberte M., Pharmaceutical Emulsions and Suspensions, 1st edition, Marcel Dekker, Inc., New York, 2000.

BP110P

PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)

Course Objectives:

This course is designed to impart a fundamental knowledge for preparation of salts and testing the presence of different ions, salts and their purity

Course Outcomes:

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

1. Understand the basics of ways of testing for the identification and quantitation of ions and salts
2. Prepare some simple inorganic pharmaceuticals.

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

Reference Books (Latest Editions to be adopted):

1. Beckett A. H., Stenlake J. B., Practical Pharmaceutical Chemistry, Vol. I & II, 2nd edition, Athlone Press, University of London, London, 1970
2. Vogel A.I., Textbook of Quantitative Inorganic Analysis, 2nd edition, Longman Green and Co., London, 1951
3. Gundu Rao P., Inorganic Pharmaceutical Chemistry, 1st edition, Vallabh Prakashan, Delhi, India, 2013
4. Bentley AO, Atherden LM, Driver JE, Textbook of Pharmaceutical Chemistry, 4th edition, Oxford University Press, London, New York, and Toronto, 1945
5. Kennedy J. H., Principles of Analytical Chemistry, 2nd edition, Saunders College Publishing, USA, 1990
6. Indian Pharmacopoeia

BP111P

COMMUNICATION SKILLS (Practical)

The following learning modules are to be conducted English language lab software (preferably using wordsworth®)

1. **Basic communication covering the following topics**
 - a. Meeting People
 - b. Asking Questions
 - c. Making Friends
 - d. What did you do?
 - e. Do's and Dont's
2. **Pronunciations covering the following topics**
 - a. Pronunciation (Consonant Sounds)
 - b. Pronunciation and Nouns
 - c. Pronunciation (Vowel Sounds)
3. **Advanced Learning**
 - a. Listening Comprehension / Direct and Indirect Speech

- b. Figures of Speech
- c. Effective Communication
- d. Writing Skills
- e. Effective Writing
- f. Interview Handling Skills
- g. E-Mail etiquette
- h. Presentation Skills

Reference Books (Latest Editions to be adopted):

1. Ruther Foord A.J., Basic Communication Skills for Technology, 2nd Edition, Pearson Education, Delhi, 2011
2. Sanjay Kumar, Pushp lata, Communication skills, 2nd Edition, Oxford Press, Lucknow 2015.
3. Robbins S.P., Organizational Behaviour, 1st Edition, Pearson, San Diego, USA, 2013.
4. Hasson G., Brilliant- Communication skills, 1st Edition, Pearson Life, UK, 2011
5. Gopala S.W., The Ace of Soft Skills: Attitude, Communication and Etiquette for success, 5th Edition, Pearson Education, Delhi, 2013.
6. Dalley D, Burton Lois, Greenhall M., Developing your influencing skills, 1st Edition Universe of Learning Ltd, Manchester, United Kingdom, 2010.
7. Konar N., Communication skills for Professionals, 2nd Edition, New arrivals –PHI Learning Pvt. Ltd, New Delhi, 2011.
8. Mitra, B.K., Personality development and soft skills, 1st Edition, Oxford Press, Lucknow, 2011.
9. Butter Field, J., Soft skill for everyone, 1st Edition, Cengage Learning India Pvt. Ltd, New Delhi, 2011.
10. Francis Peters SJ, Soft skills and professional communication, 1st Edition, McGraw Hill Education, New York, 2011.
11. Adair John, Effective communication, 4th Edition, Pan Mac Millan, 2009.
12. Daniels A.C, Bringing out the best in people, 2nd Edition, Mc Graw Hill Education, New York, 1999.

BP112RBP
Remedial Biology (Practical)

Course Objectives:

To give the learner preliminary knowledge of biology.

Course Outcomes

The learner should be able to:

1. Have knowledge of microscope and microscopic study of tissues.
2. Identify plant parts and modification.
3. Explain some body processes.

Unit	Details
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 (Latest Editions to be adopted):

1. Kale. S.R. and Kale R.R, Practical Human Anatomy and Physiology, 10th edition, Nirali Prakashan, Pune, 2020.
2. Gokhale S.B., Kokate C.K. and Shriwastava, S.P. A Manual of Pharmaceutical biology practical.
3. Shafi M, Biology practical manual according to National core curriculum. Biology forum of Karnataka.

SEMESTER IIBP201T

Human Anatomy and Physiology - II (Theory)

45 Hours

Course Objectives:

To give the learner in-depth information on the organ systems and homeostatic mechanisms.

Course Outcomes:

The learner should be able to:

1. Elucidate the gross morphology, structure and functions of various organs of the human body.
2. Understand the coordinated working pattern of different organs of each system.
3. Correlate the mechanisms in the maintenance of homeostasis of human body by cross functioning of the various systems.

Unit	Details	Hours
1	Nervous system <ul style="list-style-type: none"> • Organization of nervous system • Neuron, neuroglia, classification, and properties of nerve fibre, • Electrophysiology, action potential, nerve impulse • Receptors, synapse, and 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) 	10
2	Digestive system <ul style="list-style-type: none"> • Anatomy and physiology of the gastrointestinal tract and associated organs • Functions of stomach • Digestion and absorption of carbohydrates, proteins, and fats 	5
	Respiratory System	5

	<ul style="list-style-type: none"> Anatomy and physiology of respiratory system Exchange of gases External and internal respiration Mechanism and regulation of respiration Lung volumes and lung capacities Artificial respiration and resuscitation methods 	
	Urinary system <ul style="list-style-type: none"> 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 Role of kidneys in acid base balance Role of rennin angiotensin system 	7
	Endocrine system <ul style="list-style-type: none"> Classification of hormones Mechanism of hormone action Structure and functions of endocrine tissues and glands Disorders associated with endocrine system 	8
	Reproductive system <ul style="list-style-type: none"> 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 	10
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Waugh A, and Grant A, Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
2. Tortora G. J. & Derrickson B, Principals of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey , 2016
3. Guyton A. C., Hall J. E., Textbook of Medical Physiology, 12th edition, W. B. Saunders Company, USA/Prism Books Ltd. India, 2010.
4. Mackenna B. R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
5. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
6. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
7. Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
8. Chatterjee, C.C., Human Physiology (vol 1 and 2), 11th edition, CBS Publishers and Distributors, Kolkata., 2017.

PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)

45 Hours

Course Objectives:

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.

Course Outcomes:

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

Unit	Details	Hours
	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	
1	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 isomerism in organic compounds	6
2	Alkanes*, Alkenes* and Conjugated dienes* SP ³ hybridization in alkanes, halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP ² hybridization in alkenes E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 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	10
3	Alkyl halides* SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry, and rearrangement of carbocations. SN1 versus SN2 reactions, factors affecting SN1 and SN2 reactions Structure and uses of ethyl chloride, 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	10
4	Carbonyl compounds* (Aldehydes and ketones) Nucleophilic addition, electromeric effect, aldol condensation, crossed aldol	9

	condensation, Cannizzaro reaction, crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, structure and uses of formaldehyde, paraldehyde, acetone, chloral hydrate, hexamine, benzaldehyde, vanillin, cinnamaldehyde.	
5	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	10
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall , New Jersey, 1992
2. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Longman, 1963
3. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
4. Soni P. L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
5. Mann F. G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York, and Toronto, 1960
6. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989
7. Vishnoi N. K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979
8. Engel R. G., Pavia D. L., Lampman G. N., Kriz G. S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010
9. Ahluwalia V. K., Parashar R. K., Organic Reaction Mechanisms, 4th edition, Narosa Publishing House, 2010

BP203T

BIOCHEMISTRY (Theory)

45 Hours

Course Objectives:

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.

Course Outcomes:

Upon completion of course student shell 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.

Unit	Details	Hours
1	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	8
2	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 Phosphorylation Inhibitors ETC and oxidative phosphorylation/uncouplers Level	10
3	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 (phenylketonuria, albinism, alcaptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice	10
4	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	10

	Genetic code, Translation or Protein synthesis and inhibitors	
5	Enzymes Introduction, properties, nomenclature and IUB classification of enzymes Enzyme kinetics (Michaelis plot, Lineweaver Burke plot, Eadie Hofstee 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	7
	TOTAL	45

Reference Books (Latest Editions to be adopted):

- 1 Lehniger AL, Nelson DL, Cox MM. Lehniger Principles of Biochemistry, 7th edition, Macmillan, New York, 2017.
2. Murry RK, Granner DK, Mayes PA, Rodwell VW, Harper's Biochemistry, 23rd edition, Appleton & Lange, Connecticut, 1993.
3. Berg JM, Tymoczko JL, Stryer L. Biochemistry, 9th edition, WH Freeman, New York, 2019.
4. Satyanarayan, U and Chakrapani, U. Biochemistry, 4th edition, Elsevier, New Delhi, 2013.
5. Rao AR. Textbook of Biochemistry, 11th edition, UBS Publishers and Distributors, 2009.
6. Deb AC, Fundamentals of Biochemistry, 7th edition, New Central Book Agency, Kolkatta, 2001
7. Conn E, Stumpf P, Outlines of Biochemistry, 5th edition, John Wiley & Sons, Newyork, 1987
8. Gupta RC and Bhargava S, Practical Biochemistry, 5th edition, CBS Publishers and Distributors(P), Ltd, New Delhi.
9. Plummer DT, Introduction of Practical Biochemistry (3rd Edition), Tata McGraw-Hill Education Pvt. Ltd., 2004
10. Rajagopal, G. Ramakrishnan, Practical Biochemistry for Medical students, 1st edition, K. K. Publications, New Delhi, 1983.
11. Varley H, Gowenlock A H McMurray JR; McLauchlan DM, Practical Biochemistry, 6th edition, CBS Publishers and Distributors, New Delhi, 2006.

BP204T

Pathophysiology (Theory)

45 Hours

Course Objectives:

To impart to the learner the knowledge of pathophysiology and apply it to development of pharmacotherapeutics.

Course Outcomes

The learner should be able to:

1. Describe the etiology and pathogenesis of the selected disease states.
2. Explain the signs and symptoms of the diseases.
3. Deduce the complications of the pathology on health.

Unit	Details	Hours
1	Cell injury and Adaptation: <ul style="list-style-type: none"> • Basic principles of Introduction, definitions • Homeostasis: components and types of feedback systems • Causes of cellular injury • Mechanisms of cell injury: cell membrane damage, mitochondrial 	6

	<p>damage, ribosome damage, nuclear damage</p> <ul style="list-style-type: none"> • Morphology of cell injury: adaptive changes (atrophy, hypertrophy, hyperplasia, metaplasia, dysplasia), cell swelling, intra cellular accumulation, calcification, enzyme leakage • Cell Death and apoptosis • Acidosis & Alkalosis • Electrolyte imbalance 	
2	<p>Inflammation and repair</p> <ul style="list-style-type: none"> • Basic mechanism involved in the process of inflammation and repair: • 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 	4
3	<p>Cancer</p> <ul style="list-style-type: none"> • Classification • Etiology and pathogenesis of cancer 	2
4	<p>Cardiovascular System</p> <ul style="list-style-type: none"> • Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) 	6
5	<p>Respiratory system</p> <ul style="list-style-type: none"> • Asthma, chronic obstructive airways diseases 	2
6	<p>Renal system</p> <ul style="list-style-type: none"> • Acute and chronic renal failure 	2
	<p>Haematological Diseases</p> <ul style="list-style-type: none"> • Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia 	4
	<p>Endocrine system</p> <ul style="list-style-type: none"> • Diabetes, thyroid diseases, disorders of sex hormones 	4
	<p>Nervous system</p> <ul style="list-style-type: none"> • Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. 	6
	<p>Gastrointestinal system</p> <ul style="list-style-type: none"> • Peptic ulcer, inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease 	3
	<p>Disease of bones and joints</p> <ul style="list-style-type: none"> • Rheumatoid arthritis, osteoporosis and gout 	2
	<p>Infectious diseases</p> <ul style="list-style-type: none"> • Meningitis, typhoid, leprosy, tuberculosis, urinary tract infections 	2
	<p>Sexually transmitted diseases</p> <ul style="list-style-type: none"> • AIDS, syphilis, gonorrhea 	2
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Kumar Vinay, Abbas A.K., Aster, J.C. Robbins & Cotran Pathologic Basis of Disease; 10th edition, South Asia edition; Elsevier, India, 2014.
2. Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
3. Brunton, L.L., Hilal-Dandan R, Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
4. Best C.H., Taylor N.B., West J.B, Best and Taylor's Physiological Basis of Medical Practice; 12th edition, William and Wilkins, Baltimore, USA, 1991.
5. Walker, B., College, N.R., Ralston S., Penman, I., Davidson's Principles and Practice of Medicine; 22nd edition, Churchill Livingstone, New York, 2014.
6. Guyton A. C., Hall J. E., Textbook of Medical Physiology, 12th edition, Saunders, USA/Prism Books Ltd. India, 2010.
7. Di Piro J.T., Talbert, R.L., Yee, G.C., Matzke, G.R., Wells, B.G., Posey, L.M., Pharmacotherapy: A Pathophysiological Approach; 9th edition, McGraw-Hill Medical, London, 2014.
8. Kumar V., Cotran R.S, Robbins S. L, Basic Pathology; 7th edition; WB Saunders Company, Philadelphia/Harcourt (India) Pvt. Ltd., New Delhi, 2003.
9. Walker R, Edwards, Clinical Pharmacy and Therapeutics, 3rd edition; Churchill Livingstone Edinburgh, New York, 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.

BP205T

COMPUTER APPLICATIONS IN PHARMACY (Theory)

30 hours

Course Objectives:

This subject deals with the introduction databases, database management systems, computer application in clinical studies and use of databases.

Course Outcomes:

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

Unit	Details	Hours
1	<p>Number system: Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary <i>etc</i>, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division</p> <p>Concept of Information Systems and Software: Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project</p>	6

2	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	6
3	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	6
4	Bioinformatics: Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	6
5	Computers as data analysis in Preclinical development: Chromatographic data analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)	6
	TOTAL	30

Reference Books (Latest Editions to be adopted):

1. Fassett, W.E., Computer Application in Pharmacy, 1st edition, Lea and Febiger, Philadelphia, USA, 1986.
2. Sean E, Binghe W., Computer Application in Pharmaceutical Research and Development, 1st edition, John Wiley and Sons, Inc., New Jersey, USA, 2006.
3. Rastogi, S.C., Mendiratta, N, Rastogi, P., Bioinformatics (Concept, Skills and Applications), 2nd edition, CBS Publishers and Distributors, New Delhi, 2008.
4. Prague, C.N., Irwin, M.R., Reardon, J., Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath , Wiley India Pvt. Ltd, New Delhi

BP206T

ENVIRONMENTAL SCIENCES (Theory)

30 hours

Course Objectives:

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.

Course Outcomes:

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.

Unit	Details	Hours
1	The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources:	10

	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.	
2	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)	10
3	Environmental Pollution: air pollution; water pollution; soil pollution	10
	TOTAL	30

Reference Books (Latest Editions to be adopted):

1. Singh Y.K., Environmental Science, 1st edition, New Age International Pvt, Publishers, Bangalore, 2006.
2. Agarwal, K.C., Environmental Biology, 2nd edition, Nidhi Publishers, Bikaner, 2008.
3. Bharucha E, The Biodiversity of India, 1st edition, Mapin Publishing Pvt. Ltd., Ahmedabad, India, 2002.
4. Brunner C.R., Hazardous Waste Incineration, McGraw Hill Inc, USA, 1989
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorham, E & Hepworth, M.T., Environmental Encyclopedia, 2nd edition, Cengage Gale, USA, 2001.
7. De A.K., De A.K., Environmental Chemistry, New Age International Publishers Ltd, New Delhi, 1990.
8. Narain S, Down to Earth- fortnightly magazine focused on politics of environment and development of Centre for Science and Environment, New Delhi, India,

BP207P

Human Anatomy and Physiology II (Practical)

Course Objectives:

To get the learner adept with anatomy, physiology and pathology of body systems.

Course Outcomes

The learner should be able to:

1. Be proficient with the working of the systems of the body including the process of homeostasis.
2. Identify and describe the various body tissues and the pathological changes in diseased states.

Unit	Details
1	Study of the systems with the help of models, charts, and specimens: <ul style="list-style-type: none"> • Nervous system • Endocrine system • Digestive • Respiratory • Cardiovascular • Urinary • Reproductive
2	To demonstrate the general neurological examination.

3	To study the integumentary and special senses using specimen, models, etc.: <ul style="list-style-type: none"> • Touch • Olfaction • Taste • Vision and visual acuity
4	To demonstrate the reflex activity.
5	Recording of body temperature.
6	To demonstrate positive and negative feedback mechanism.
7	Determination of tidal volume and vital capacity.
8	Recording of basal mass index.
10	Study of family planning devices and pregnancy diagnosis test.
11	Demonstration of total blood count by cell analyser
12	Permanent slides of vital organs and gonads: <ul style="list-style-type: none"> • Ovary, Testis, Liver, Pancreas, Thyroid, Tongue, Stomach, Intestine, Kidney, Lung, Spinal Cord, Cerebrum, Artery, Vein
13	Discussion on some common investigational procedures used in diagnostics: <ol style="list-style-type: none"> 1) Electroencephalogram (EEG) 2) Positron emission tomography (PET) 3) Computed tomography scan (CT Scan) 4) Flow cytometry as a diagnostic tool 5) Polymerase chain reaction as a diagnostic tool 6) Electrocardiogram (ECG) in diagnosis of cardiac arrhythmia 7) Liver Function tests 8) Kidney Function tests 9) Blood Glucose 10) Serum Cholesterol / Triglycerides 11) Serum Calcium 12) Thyroid Function tests 13) Diagnostic tests for infectious diseases like - Malaria, Tuberculosis, Dengue, H1N1 swine flu , Typhoid

Reference Books (Latest Editions to be adopted):

1. Mackenna B. R. & Callander R., McNaught & Callander's, Illustrated Physiology, 5th edition Churchill Livingstone, New York, 2012.
2. Kaplan, Jack, Opheim, Toivola, Lyon, Clinical Chemistry: Interpretation & Techniques, 4th edition Lippincott, Williams and Wilkins, USA, 1995.
3. Godkar P.B., Godkar, D.P., Textbook of Medical Laboratory Technology, 3rd edition, Bhalani Publishing House, Mumbai, India, 2014.
4. Ghai C. L., Textbook of Practical Physiology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2005.
5. Mohan H, Textbook of Pathology, 6th edition, Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi, 2010.
6. Waugh A, and Grant A, Ross & Wilson, Anatomy & Physiology in Health & Illness, 9th edition, Churchill Livingstone, New York, 2001.
7. Tortora G. J. & Derrickson B, Principles of Anatomy & Physiology, 15th edition, John Wiley and Sons, Inc., New Jersey , 2016

8. Guyton A. C., Hall J. E., Textbook of Medical Physiology, 12th edition, W. B. Saunders Company, USA/Prism Books Ltd. India, 2010.

BP208P

PHARMACEUTICAL ORGANIC CHEMISTRY - I (Practical)

Course Objectives:

To get the learner introduced to the basic principles of qualitative organic analysis

Course Outcomes

The learner should be able to:

1. Conduct simple test to detect the physicochemical nature of organic compounds and the elemental composition of organic compounds
2. Identify presence of different functional groups in organic compounds by specific tests, identify compounds and conduct confirmatory tests.

Unit	Details
1	<p>Systematic qualitative analysis of unknown organic compounds like</p> <ol style="list-style-type: none"> 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 five unknown organic compounds to be analyzed systematically
2	Preparation of suitable solid derivatives from organic compounds
3	Construction of molecular models

Reference Books (Latest Editions to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992
2. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963
3. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
4. Soni P. L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
5. Mann F. G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York and Toronto, 1960
6. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989
7. Vishnoi N. K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979

8. Engel R. G., Pavia D. L., Lampman G. N., Kriz G. S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010
9. Ahluwalia V. K., Parashar R. K., Organic Reaction Mechanisms, 4th edition, Narosa Publishing House, 2010

BP209P
BIOCHEMISTRY (Practical)

Course Objectives:

To get the learner introduced to the basic principles of qualitative and quantitative determination of important biomolecules

Course Outcomes

The learner should be able to:

1. Conduct tests for qualitative determination of simple biochemical compounds
2. Conduct assays for quantitative determination of simple biochemical compounds
3. Conduct simple experiments to analyse properties of enzymes

Unit	Details
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

Reference Books (Latest Editions to be adopted):

- 1 Lehninger AL, Nelson DL, Cox MM. Lehninger Principles of Biochemistry, 7th edition, Macmillan, New York, 2017.
2. Murry RK, Granner DK, Mayes PA, Rodwell VW, Harper's Biochemistry, 23rd edition, Appleton & Lange, Connecticut, 1993.
3. Berg JM, Tymoczko JL, Stryer L. Biochemistry, 9th edition, WH Freeman, New York, 2019.
4. Satyanarayan, U and Chakrapani, U. Biochemistry, 4th edition, Elsevier, New Delhi, 2013.
5. Rao AR. Textbook of Biochemistry, 11th edition, UBS Publishers and Distributors, 2009.
6. Deb AC, Fundamentals of Biochemistry, 7th edition, New Central Book Agency, Kolkatta, 2001
7. Conn E, Stumpf P, Outlines of Biochemistry, 5th edition, John Wiley & Sons, Newyork, 1987
8. Gupta RC and Bhargava S, Practical Biochemistry, 5th edition, CBS Publishers and Distributors(P), Ltd, New Delhi.
9. Plummer DT, Introduction of Practical Biochemistry (3rd Edition), Tata McGraw-Hill Education Pvt. Ltd., 2004

10. Rajagopal, G. Ramakrishnan, Practical Biochemistry for Medical students, 1st edition, K. K. Publications, New Delhi, 1983.
11. Varley H, Gowenlock A H McMurray JR; McLauchlan DM, Practical Biochemistry, 6th edition, CBS Publishers and Distributors, New Delhi, 2006.

BP210P
COMPUTER APPLICATIONS IN PHARMACY (Practical)

Unit	Details
1	Design a questionnaire using a word processing package to gather information about a 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	Creating mailing labels Using Label Wizard, generating label in MS WORD
6	Create a database in MS Access to store the patient information with the required fields Using MS Access
7	Design a form in MS Access to view, add, delete, and modify the patient record in the database
8	Generating report and printing the report from patient database
9	Creating invoice table using – MS Access
10	Drug information storage and retrieval using MS Access
11	Creating and working with queries in MS Access
12	Exporting Tables, Queries, Forms and Reports to web pages
13	Exporting Tables, Queries, Forms and Reports to XML pages

Reference Books (Latest Editions to be adopted):

1. Fassett, W.E., Computer Application in Pharmacy, 1st edition, Lea and Febiger, Philadelphia, USA, 1986.
2. Sean E, Binghe W., Computer Application in Pharmaceutical Research and Development, 1st edition, John Wiley and Sons, Inc., New Jersey, USA, 2006.
3. Rastogi, S.C., Mendiratta, N, Rastogi ,P., Bioinformatics (Concept, Skills and Applications), 2nd edition, CBS Publishers and Distributors, New Delhi, 2008.
4. Prague, C.N., Irwin, M.R., Reardon, J., Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath , Wiley India Pvt. Ltd, New Delhi

SEMESTER III
BP301T

PHARMACEUTICAL ORGANIC CHEMISTRY–II (Theory)

45 Hours

Course Objectives:

To introduce the learner to

1. The general methods of preparation and reactions of some organic compounds.
2. Reactivity of organic compounds.
3. Mechanisms and orientation of reactions.
4. Chemistry of fats and oils.

Course Outcomes:

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. Give an account of the reactivity/stability of compounds,
4. Understand the scheme for the preparation of organic compounds

Unit	Details	Hours
	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	
1	Benzene and its derivatives	10
1.1	Analytical, synthetic, and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule	3
1.2	Reactions of benzene - nitration, sulphonation, halogenation-reactivity, Friedel-Crafts alkylation- reactivity, limitations, Friedel-Crafts acylation.	3
1.3	Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction	3
1.4	Structure and uses of DDT, Saccharin, BHC and Chloramine	1
2		10
2.1	Phenols* - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol, naphthols	5
2.2	Aromatic Amines* - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts	3
2.3	Aromatic Acids* -Acidity, effect of substituents on acidity and important reactions of benzoic acid.	2
3	Fats and Oils	10
3.1	Fatty acids – reactions.	4
3.2	Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils	3
3.3	Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	3
4	Polynuclear hydrocarbons:	08
4.1	Synthesis, reactions	4
4.2	Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	4
5	Cycloalkanes	07
	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	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall , New Jersey, 1992
2. Pine, Stanley H.; Hendrickson, James B.; Cram, Donald J.; Hammond, George S., Organic Chemistry, 4th edition, McGraw Hill Publications, USA, 1982

3. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963
4. March J., Smith M. B., Advanced Organic Chemistry: Reactions, Mechanisms, Structures, 6th edition, John Wiley and Sons publication, USA, 2007
5. Carey F. A., Sundberg R. J., Organic Chemistry, Part A: Structures and Mechanism, Part B: Reactions and Synthesis, 4th edition Kluwer Academic Publishers, USA, 2002
6. Sykes P., A Guidebook to Mechanism in Organic Chemistry, 6th edition, Pearson Education, India, 1960
7. Dewick P., Essentials of Organic chemistry, 1st edition, John Wiley and Sons, New Jersey, 2006
8. Wade L.G. Jr., Maya Shankar Singh, Advanced Organic Chemistry: Reactions and Mechanism, 9th edition, Pearson Education, India, 2019
9. Eliel E. L., Wilen S. H., Stereochemistry of Organic Compounds, 1st edition, John Wiley and Sons, USA, 1994
10. Sorrell T. N., Organic Chemistry, 2nd edition, University Science Books, USA, 2005
11. Kalsi P. S., Stereochemistry: Conformation and Mechanism, Organic Reactions and Their Mechanisms, New age International publishers, New Delhi, 2017
12. Brahmachari G., Organic Chemistry through Solved Problems, revised edition, Alpha Science International Ltd., Morgan & Claypool Publishers, 2007
13. Brahmachari G., Organic Name Reactions: A Unified Approach, Alpha Science International Ltd., Morgan and Claypool Publications, 2006

BP302T

PHYSICAL PHARMACEUTICS-I (Theory)

45 Hours

Course Objectives:

The objective of the course is to train the learner for understanding the basic physical principles underlying pre-formulation testing, formulation development and finished product testing of drug delivery systems.

Course Outcomes:

Upon the completion of the course student shall be able to

1. Understand various physicochemical properties of drug molecules in the formulation development and evaluation of dosage forms.
2. Demonstrate pharmaceutical applications of surface and interfacial phenomenon
3. Apply knowledge of solubility aspects in developing stable dosage form
4. Acquire understanding of mechanism of diffusion, dissolution, and dissolution kinetics
5. Know drug complexes, protein binding and their applications

Unit	Details	Hours
1	UNIT-I	10
	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, solid crystalline, amorphous & polymorphism.	6
	Physicochemical properties of drug molecules: Additive, constitutive, and colligative properties with examples; Concept of tonicity in pharmacy, methods to adjust isotonicity; Refractive index and molar	4

	refraction, optical rotation, dielectric constant, dipole moment, determinations, and applications	
2	UNIT-II 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. Adsorption isotherms, Freundlich adsorption isotherm, Langmuir adsorption isotherm Wetting, wetting agents and contact angle	8
3	UNIT-III Solubility of drugs: Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	14
	Diffusion and Dissolution: Diffusion; diffusion through biological membranes, Fick's Laws of diffusion, Steady state diffusion, driving forces for diffusion in pharmaceutical systems, permeability. Measurement of diffusion; Concept of dissolution, dissolution mechanism; Noyes Whitney equation, factors affecting dissolution; Intrinsic Dissolution Rate, Hixson – Crowell Law, measurement of dissolution rates	7
4	UNIT-IV pH, buffers and Isotonic solutions: Theory of dissociation, dissociation constant, 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.	6
5	UNIT-V 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	7
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly. Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.

5. Stocklosa M. J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, PharmaMed Press, 2017
9. C.V.S. Subramanyam, J. Thimma settee, Laboratory Manual of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2014.
10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017
12. Jain G, Khar RK, Ahmad FJ, Theory and Practice of Physical Pharmacy, 1st Edition, Elsevier India, 2013
13. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.

BP303T

PHARMACEUTICAL MICROBIOLOGY (Theory)

45 Hours

Course Objectives:

Study morphology, classification, and reproduction of all categories of microorganisms especially which cause diseases, microbiological tests, aseptic handling, and sterilization aspects.

Course Outcomes:

Upon completion of the subject student shall be able to:

1. Illustrate methods of identification, cultivation, and preservation of various microorganisms
2. Understand the disease-causing microorganisms, symptoms, and treatment avenues.
3. Recognize the importance and implementation of sterilization in pharmaceutical processing and industry and sterility testing of pharmaceutical products.
4. Comprehend out microbiological standardization of Pharmaceuticals.
5. Know the cell culture technology and its applications in pharmaceutical industries.

Unit	Details	Hours
1	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 simple & compound microscope, phase contrast microscopy, dark field microscopy and electron microscopy.	08
2	Study of morphology, classification, reproduction/replication and cultivation of Bacteria, Fungi, Viruses and Rickettsiae and Chlamydiae. Overview of bacterial diseases and pathogens causing them. Mycobacteria, shigella, pseudomonas, klebsiella, streptococcus, staphylococcus, clostridium vibrio	13

	<p>Viral diseases including new emerging viral diseases -COVID, ZICA, SARS, EBOLA</p> <p>Fungal diseases</p> <p>Protozoal diseases- Amoeba, Paramecium, Trichomonas, Plasmodium</p> <p>Rickettsial & Chlamydial diseases</p> <p>Protozoa- Morphological characteristics and classification, reproduction, pathogenic protozoa like Amoeba, Paramecium, Trichomonas, Plasmodium</p> <p>Algae - Classification, Morphological characteristics, reproduction, economic significance of algae.</p> <p>Pattern of microbial death</p>	
3	<p>Identification of bacteria using staining techniques (simple, Gram's & Acid-fast staining) and biochemical tests (IMViC).</p> <p>Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins, and amino acids.</p> <p>Assessment of a new antibiotic.</p>	06
4	<p>Classification and mode of action of disinfectants</p> <p>Factors influencing disinfection, antiseptics, and their evaluation. For bacteriostatic and bactericidal actions, Evaluation of bactericidal & Bacteriostatic.</p> <p>Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP. 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.</p> <p>Equipments employed in large scale sterilization. Sterility indicators.</p> <p>Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification.</p>	10
5	<p>Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources, and types of microbial contaminants, assessment of microbial contamination and spoilage.</p> <p>Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.</p> <p>Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.</p> <p>Application of cell cultures in pharmaceutical industry and research. Disposal of Microbial waste</p>	08
	TOTAL	45

Reference Books (Latest Editions to be adopted):

- 1.Hugo W.B. and Russel A.D, Pharmaceutical Microbiology, 8th Edition, Blackwell Scientific publications, Oxford, London, 2013.
- 2.Reed G., Prescott and Dunn's., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2004.
3. Pelczar MJ, Chan ECS, Kreig NR. Microbiology, 6th Edition, Tata McGraw Hill Education Pvt. Ltd, Delhi, 1993

4. Harris M, Tindall B, and Cox, Pharmaceutical Microbiology, 1st edition, 1964, The Williams and Wilkins, Baltimore, 1964.
5. Rose AH, Industrial Microbiology, 1st edition, Butterworths (Elsevier), Oxford, 1961.
6. Frobisher M, HinsDill RD, Crabtree KT, Good Heart CR, Fundamentals of Microbiology, 9th edition, Japan, 1974.
7. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
8. Pepler HJ, Microbial Technology, 2nd Edition, Academic Press (Elsevier), Massachusetts, 1979.
9. I.P., B.P., U.S.P.- latest editions.
10. Reba Kanungo, Ananthnarayan and Paniker's Textbook of Microbiology, 10th Edition, Orient-Longman, Chennai, 2017.
11. Pommerville, J.C., Alcamo's Fundamentals of Microbiology, 3rd Edition, Jones and Bartlett, Burlington, Massachusetts, 2014.
12. Jain N.K, Pharmaceutical Microbiology, 3rd Edition, Vallabh Prakashan, Delhi, 2001.
13. Garry G.M., Bergey's Manual of Systematic Bacteriology, 2nd Edition, Springer publishing, New York, 2005.

BP304T

PHARMACEUTICAL ENGINEERING (Theory)

45 Hours

Course Objectives:

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

Course Outcomes: Upon completion of the course student shall be able:

1. To Understand mechanics of fluid, fluid flow, and its measurements
2. To know various unit operations used in Pharmaceutical manufacturing and material handling systems
3. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.
4. Define and categorize the different industrial hazards.

Unit	Details	Hours
	UNIT-I	10
1	<p>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</p> <p>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.</p> <p>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.</p> <p>Material handling systems: Conveyers and Pumps</p>	
	UNIT-II	10

2	<ul style="list-style-type: none"> • Heat and Mass Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. Temperature measurement-basic principles and devices. Mass transfer in turbulent and laminar flow. Concept of interfacial mass transfer • 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 	
3	UNIT-III	10
	<ul style="list-style-type: none"> • 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. 	
4	UNIT-IV	8
	<ul style="list-style-type: none"> • 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. 	
5	UNIT-V	7
	<ul style="list-style-type: none"> • 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 their prevention. Ferrous and nonferrous metals, inorganic and organic non-metals, basic of material handling systems. • Hazards: Sources of hazards in pharmaceutical industry and their prevention 	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Badger W.L. & Banchero J., Introduction to chemical engineering, Published by Tata McGraw Hill, International edition, New Delhi, 1955
2. Perry R.H., Green D.W., Maloney O, Perry's Chemical Engineer's Handbook -.7th Edition, McGraw Hill Inc., New York, 1998.

3. McCabe, Smith & Harriott. Unit Operations of Chemical Engineering, Published by McGraw Hill Inc., 5th edition, 1993.
4. Subramanyam C.V.S., Pharmaceutical Engineering: Unit Operations - Principles and Practice, Vallabh Prakashan, Delhi., 3rd edition, 2019.
5. Remington A, The Science & Practice of Pharmacy. Lippincott, Williams & Wilkins Philadelphia. 21st edition, 2006.
6. Lachman L., Lieberman H.A. & Kanjig J.L, The Theory & Practice of Industrial Pharmacy, 3rd edition, Varghese Publishing House, Bombay, 1990.
7. K. Sambamurthy, Pharmaceutical Engineering, New Age International Publishers, Delhi, 2005.
8. Subrahmanyam C.V.S., Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015.
9. Subrahmanyam C.V.S., Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017.
10. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
11. Sona P.S., A Practical Manual of Pharmaceutical Engineering, University Science Press, New Delhi, India.
12. Simpson N.J.K., Solid phase extraction, Principles, techniques, and applications, Marcel Dekker Inc. USA, 2000.

BP305P

PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)

Course Objectives:

To get the learner introduced to the basic principles of organic synthesis

Course Outcomes

The learner should be able to:

1. Prepare simple organic compounds by following GLP and Safety practice
2. Conduct some simple assays for determination of some properties of samples.

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-naphthol from Aniline by diazotization and coupling reactions.
- Benzil from Benzoin by oxidation reaction.
- Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction
- Cinnamic acid from Benzaldehyde by Perkin reaction
- *P*-Iodo benzoic acid from *P*-amino benzoic acid

Reference Books (Latest Editions to be adopted):

1. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall , New Jersey, 1992.
2. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963.
3. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017.
4. Soni P. L., Organic Chemistry, 29th edition, S. Chand publishing, Delhi, India, 2007
5. Mann F. G., Practical Organic Chemistry, 4th Edition, Bernard Charles Saunders, Longman, London, New York and Toronto, 1960.
6. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989.
7. Vishnoi N. K., Advanced Practical Organic Chemistry, 1st edition, Vikas Publishing House, Mumbai, 1979.
8. Engel R. G., Pavia D. L., Lampman G. N., Kriz G. S., Introduction to Organic Laboratory Techniques, Cengage Learning, India, 2010

BP306P

PHYSICAL PHARMACEUTICS – I (Practical)

Course Objectives:

The objective of the course is to teach the learner the methods for the determination of different physical parameters underlying pre-formulation testing, formulation development and finished product testing of drug delivery systems.

Course Outcomes:

The learner should be able to:

1. To understand the principles and methods for the determination of various physical parameters of drugs and formulations.
2. To carry out various physical tests involved in characterization of drugs.
3. To demonstrate testing of various physical parameters involved in pre-formulation and formulation development and evaluation.

List of Experiments

1	Determination the solubility of drug at room temperature
2	Determination of pKa value by Half Neutralization/ Henderson Hassel balch equation.
3	Determination of Partition co- efficient of benzoic acid in benzene and water
4	Determination of Partition co- efficient of Iodine in CCl ₄ and water (Demonstration)
5	Determination of CST of phenol water system and % 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 charcoal
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 (Demonstration)
12	To determine the refractive index of liquids using Abbe's Refractometer
13	To determine the concentration of an unknown solution of an optically active substance using polarimeter
14	To determine the molecular weight of ionizable and nonionizable solute by ebullioscopy (Lands Berger Method)

Recommended Books (Latest Editions to be adopted):

1. Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly. Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
5. Stocklosa M. J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., Newyork, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, PharmaMed Press, 2017
9. C.V.S. Subramanyam, J. Thimma settee, Laboratory Manual of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2014.
10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017
12. Jain G, Khar RK, Ahmad FJ, Theory and Pracice of Physical Pharmacy, 1st Edition, Elsevier India, 2013
13. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.

BP307P
PHARMACEUTICAL MICROBIOLOGY (Practical)

Course Objectives:

To introduce the learner to some of the common techniques used in microbiological techniques and experiments

Course Outcomes:

Upon completion of the course the student will be able to:

1. Characterization and identification of bacteria using various staining techniques (morphological study), colony characterization, serological and biochemical characteristics
2. Analyze quality of raw material, food and water and assessment of extent of microbial contamination using counting technique and Evaluate sterility of products.
3. To impart the knowledge of bioassay of antibiotic and test antibiotic sensitivity of few antibiotics.

Course content:

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), negative staining, capsule staining, cell wall staining
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.
11	Microbial Total counts by Breeds smear method (Demo), Microbial Growth by optical density, total plate count (Demo)

Recommended Books (Latest edition to be adopted):

1. Hugo W.B. and Russel A.D, Pharmaceutical Microbiology, 8th Edition, Blackwell Scientific publications, Oxford, London, 2013.
2. Reed G., Prescott and Dunn's., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi, 2004.
3. Pelczar MJ, Chan ECS, Kreig NR. Microbiology, 6th Edition, Tata McGraw Hill Education Pvt. Ltd, Delhi, 1993
4. Harris M, Tindall B, and Cox, Pharmaceutical Microbiology, 1st edition, 1964, The Williams and Wilkins, Baltimore, 1964.
5. Rose AH, Industrial Microbiology, 1st edition, Butterworths (Elsevier), Oxford, 1961.
6. Frobisher M, HinsDill RD, Crabtree KT, Good Heart CR, Fundamentals of Microbiology, 9th edition, Japan, 1974.

- 7 Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
8. Peppler HJ, Microbial Technology, 2nd Edition, Academic Press (Elsevier), Massachusetts, 1979.
9. I.P., B.P., U.S.P.- latest editions.
10. Reba Kanungo, Ananthnarayan and Paniker's Textbook of Microbiology, 10th Edition, Orient-Longman, Chennai, 2017.
11. Pommerville, J.C., Alcamo's Fundamentals of Microbiology, 3rd Edition, Jones and Bartlett, Burlington, Massachusetts, 2014.
12. Jain N.K, Pharmaceutical Microbiology, 3rd Edition, Vallabh Prakashan, Delhi, 2001.
13. Garry G.M., Bergey's Manual of Systematic Bacteriology, 2nd Edition, Springer publishing, New York, 2005.

BP308P
PHARMACEUTICAL ENGINEERING (Practical)

Course objectives:

To familiarize the learner with unit operations encountered in manufacturing of pharmaceuticals and provide training in operating and handling of instruments and equipment and an understanding of manufacturing processes.

Course Outcomes:

The learner should be able to

1. Understand the construction and operation of various machines and equipment encountered in pharmaceutical manufacturing unit operations
2. Analyze various unit processes and factors involved to design and apply it to solve problems encountered in manufacturing
3. Understand and apply the calculation of various coefficients and variables that govern unit operations in order to maximise efficiency of the processes.

1	Determination of radiation constant of brass, iron, unpainted and painted glass.
2	Simple distillation – To calculate the efficiency of simple distillation.
3	Steam distillation – (Demonstration)
4	To determine the overall heat transfer coefficient by heat exchanger
5	Construction of drying curves (for calcium carbonate and starch)
6	Determination of moisture content and loss on drying
7	Determination of humidity of air – i) From wet and dry bulb temperatures –use of Dew point method
8	Description of Construction working and application of Pharmaceutical Machinery such as fluid energy mill, de humidifier
9	Size analysis by sieving – To evaluate size distribution of tablet granulations – Construction of various size frequency curves including arithmetic and logarithmic probability plots
10	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
11	Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer

	and such other major equipment
12	Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
13	To study the effect of time on the Rate of Crystallization
14	To calculate the uniformity Index for given sample by using Double Cone Blender

Recommended Books: (Latest Editions to be adopted):

1. Badger W.L. & Banchero J., Introduction to chemical engineering, Published by Tata McGraw Hill, International edition, New Delhi, 1955
2. Perry R.H., Green D.W., Maloney O, Perry's Chemical Engineer's Handbook -.7th Edition, McGraw Hill Inc., New York, 1998.
3. McCabe, Smith & Harriott. Unit Operations of Chemical Engineering, Published by McGraw Hill Inc., 5th edition, 1993.
4. Subramanyam C.V.S., Pharmaceutical Engineering: Unit Operations - Principles and Practice, Vallabh Prakashan, Delhi., 3rd edition, 2019.
5. Remington A, The Science & Practice of Pharmacy. Lippincott, Williams & Wilkins Philadelphia. 21st edition, 2006.
6. Lachman L., Lieberman H.A. & Kanjig J.L, The Theory & Practice of Industrial Pharmacy, 3rd edition, Varghese Publishing House, Bombay, 1990.
7. K. Sambamurthy, Pharmaceutical Engineering, New Age International Publishers, Delhi, 2005.
8. C.V.S Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015.
9. C.V.S Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017.
10. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
11. Sona P.S., A Practical Manual of Pharmaceutical Engineering, University Science Press, New Delhi, India.
12. Simpson N.J.K., Solid phase extraction, Principles, techniques, and applications, Marcel Dekker Inc. USA, 2000.

SEMESTER IV

BP401T

PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)

45 Hours

Course Objectives:

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

Course Outcomes:

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

Unit	Details	Hours
	Note: To emphasize on definition, types, mechanisms, examples, uses/applications	
1		10

	Stereoisomerism Optical isomerism – i. Optical activity, enantiomers, diastereoisomers, meso compounds ii. Elements of symmetry, chiral and achiral molecules iii. DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers iv. Reactions of chiral molecules (Stereospecific and stereoselective aspects) v. Racemic modification and resolution of racemic mixture. vi. Asymmetric synthesis: partial and absolute	
2		10
	Geometrical isomerism i. Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) ii. Methods of determination of configuration of geometrical isomers. iii. Conformational isomerism in Ethane, n-Butane and Cyclohexane. iv. Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.	
3		10
	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	
4		08
	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	
5	Reactions of synthetic importance	07
5.1	Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction	2
5.2	Oppenauer-oxidation and Dakin reaction.	2
5.3	Beckmann rearrangement and Schmidt rearrangement	2
5.4	Claisen-Schmidt condensation	1
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Finar I. L., Organic Chemistry, Vol. 1, 4th edition, Pearson Publishing House, Longman, 1963
2. Bahl B. S., Bahl A., Textbook of Organic Chemistry, 22nd edition, S. Chand publishing, Delhi, India, 2017
3. Bansal R. K., Heterocyclic Chemistry, 4th edition, Anshan Limited, India, 2008
4. Morrison R. T., Boyd R. N., Organic Chemistry, 6th edition, Prentice Hall, New Jersey, 1992
5. Gilchrist T.L., Heterocyclic Chemistry, 3rd edition, Prentice Hall, New Jersey, 1997

BP402T

MEDICINAL CHEMISTRY – I (Theory)

45 Hours

Course Objectives:

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.

Course Outcomes:

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

Unit	Details	Hours
	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*	
1	Introduction to Medicinal Chemistry	10
1.1	History and development of medicinal chemistry	1
1.2	Physicochemical properties in relation to biological action Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism	4
1.3	Drug metabolism <ul style="list-style-type: none"> • Drug metabolism principles- Phase I and Phase II. • Factors affecting drug metabolism including stereo chemical aspects 	5
2	Drugs acting on Autonomic Nervous System	10
2.1	Adrenergic Neurotransmitters: <ul style="list-style-type: none"> • Biosynthesis and catabolism of catecholamine. • Adrenergic receptors (Alpha & Beta) and their distribution. 	2
2.2	Sympathomimetic agents: SAR of Sympathomimetic agents <ul style="list-style-type: none"> • Direct acting: Norepinephrine, 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. 	4
2.3	Adrenergic Antagonists: <ul style="list-style-type: none"> • 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. 	4
3	Cholinergic neurotransmitters	10
3.1	Biosynthesis and catabolism of acetylcholine. Cholinergic receptors (Muscarinic & Nicotinic) and their distribution	2
3.2	Parasympathomimetic agents: SAR of Parasympathomimetic agents <ul style="list-style-type: none"> • Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. • Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible): Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorophate, Echothiophate iodide, 	4

	Parathione, Malathion. • Cholinesterase reactivator: Pralidoxime chloride.	
3.3	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.	4
4	Drugs acting on Central Nervous System	08
4.1	Sedatives and Hypnotics: • Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem • Barbiturates: SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Amobarbital, Butabarbital, Pentobarbital, Secobarbital • Miscellaneous: Amides and imides: Glutethimide. Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.	3
4.2	Antipsychotics • Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride. • Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine. • Fluro buterophenones: Haloperidol, Droperidol, Risperidone. • Beta amino ketones: Molindone hydrochloride. • Benzamides: Sulpiride	3
4.3	Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action • Barbiturates: Phenobarbitone, Methabarbitol. • 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	2
5	Drugs acting on Central Nervous System	07
5.1	General anesthetics: • Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. • Ultra short acting barbiturates: Methohexital sodium*, Thiamylal sodium,	3

	Thiopental sodium.	
5.2	<ul style="list-style-type: none"> • Dissociative anesthetics: Ketamine hydrochloride.* • Narcotic and non-narcotic analgesics • Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anileridine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. • Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride 	2
5.3	Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazone	2
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Beale J. M., Block J. H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T. L., Williams D. A., Roche V. F., Zito., S. W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001
3. Abraham D. J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003
4. Smith H. J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005
6. Martindale: The Extra Pharmacopoeia, Pharmaceutical Press, 2008
7. Finar I. L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicer D., The Organic Chemistry of Drug Synthesis, Vol. 1-5, Wiley-Interscience, 2007
9. Indian Pharmacopoeia
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989

BP403T

PHYSICAL PHARMACEUTICS-II (Theory)

45 Hours

Course objectives:

The course deals with the various physical 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.

Course outcomes: Upon the completion of the course student shall be able :

1. To understand the basic principles of coarse, and colloidal dispersions
2. To know the rheological and micromeritic concepts in pharmacy
3. To principles chemical kinetics in stability of drug molecule

4. To describe the laws of thermodynamics and applications of thermochemistry

Unit	Details	Hours
1	UNIT-I Thermodynamics: First law and second law of thermodynamics; Concept of enthalpy, entropy and free energy, Gibbs equation, thermochemistry.	5
2	UNIT-II 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.	8
3	UNIT-III 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.	7
4	UNIT-IV 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	7
5	UNIT-V Micromeritics: 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.	8
6	UNIT-VI 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	10
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly. Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
5. Stocklosa M. J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, PharmaMed Press, 2017
9. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.
10. C.V.S. Subrahmanyam, Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam, Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017

BP404T

PHARMACOLOGY-I (Theory)

45 Hours

Course Objectives:

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 will impart information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics), routes of administration of different classes of drugs along with the adverse effects, clinical uses, interactions, doses and contraindications that can be bridged to the clinical settings.

Course Outcomes:

Upon completion of this course the student should be able to

1. Understand the pharmacological actions of different categories of drugs and comprehend the pharmacokinetic and pharmacodynamic principles.
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Understand autonomic transmission and discuss the pharmacology of drugs acting on ANS and rationalize their therapeutic applications.
4. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
5. Explain the features of adverse drug reactions and drug interactions and appreciate correlation of pharmacology in bio medical disciplines like drug discovery and pharmacovigilance.

Unit	Details	Hours
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1	General Pharmacology	8
1.1	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	4
1.2	Pharmacokinetics- Membrane transport, absorption, distribution, metabolism, and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination	4
2	General Pharmacology	12
2.1	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.	6
2.2	Adverse drug reactions.	2
2.3	Drug interactions (pharmacokinetic and pharmacodynamic)	2
2.4	Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance	2
3	Pharmacology of peripheral nervous system	10
3.1	Organization and function of ANS, Neurohumoral transmission, co-transmission and classification of neurotransmitters	1
3.2	Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics	3
3.3	Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).	2
3.4	Local anesthetic agents	3
3.5	Drugs used in myasthenia gravis and glaucoma	1
4	Pharmacology of central nervous system	08
4.1	Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.	1
4.2	General anesthetics and pre-anesthetics.	2
4.3	Sedatives, hypnotics and centrally acting muscle relaxants	2
4.4	Anti-epileptics	2
4.5	Alcohols and disulfiram	1
5	Pharmacology of central nervous system	07
5.1	Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens	2
5.2	Drugs used in Parkinson's disease and Alzheimer's disease.	1
5.3	CNS stimulants and nootropics	1
5.4	Opioid analgesics and antagonists	2
5.5	Drug addiction, drug abuse, tolerance and dependence.	1
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Ritter J. M., Flower R. J., Henderson G, Loke Y, MacEwan D, Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.

2. Katzung B. G., Masters S. B., Trevor A. J., Basic and Clinical Pharmacology, 14th edition, Tata Mc Graw-Hill Education, Pvt. Ltd, 2017
3. Brunton, L.L., Hilal-Dandan R, Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
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. Zeind C.S, Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
6. Harvey R, Clark MA, Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
7. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
8. Sharma H. L., Sharma K. K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
9. Craig C.R., Stitzel, R.E, Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
10. Ghosh MN. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
11. Kulkarni SK. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
12. Walker R, Edwards, Clinical Pharmacy and Therapeutics, 3rd edition; Churchill Livingstone Edinburgh, New York, 2003
13. Tipnis and Bajaj, Clinical Pharmacy, 3rd edition, Career Publications, Nasik, 2017.
14. Bennett PN, Brown MJ, Clinical Pharmacology, 12th edition, Elsevier, Edinburg, 2019.
15. Parthisarathi G., Nyfort-Hansen K., Nahata M. C., 1st edition, Textbook of Clinical Pharmacy Practice; Essential Skills and Concepts, Orient Longman Pvt, Ltd, Hyderabad, 2004.

BP405T

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)

45 Hours

Course Objectives:

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

Course Outcomes:

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

Unit	Details	Hours
1		10
1.1	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,	3

	gums and mucilages, oleoresins and oleo- gum -resins).	
1.2	Classification of drugs: Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs	2
1.3	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, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	5
2		12
2.1	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	10
2.2	Conservation of medicinal plants	2
3		7
	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	
4		10
4.1	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	3
4.2	Introduction to secondary metabolites: Definition, classification, properties, and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	7
5	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs	08
	(a) Plant Products: Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens	3
	(b) 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 Primary metabolites: (c) Carbohydrates: Acacia, Agar, Tragacanth, Honey (d) Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).	3
	(e) Lipids (Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees	2

	Wax (f) Marine Drugs: Novel medicinal agents from marine sources	
	TOTAL	45

Reference Books (Latest Editions to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, J & A Churchill Ltd, London, 1946.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, CBS Publishers & Distributors, New Delhi.2018
5. Kokate C.K., Purohit A. P., Gokhale S.B., Textbook of Pharmacognosy, 37th Edition, Nirali Prakashan, New Delhi, 2007
6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996
7. Ansari S. H., Essentials of Pharmacognosy, 2nd edition, Birla Publications, New Delhi, 2007
8. Kokate C.K., Purohit A. P., Gokhale S.B, Practical Pharmacognosy, Nirali Prakashan, New Delhi, 2008.
9. Iyengar M.A and Nayak S.G.K, Anatomy of Crude Drugs, 12th edition, PharmaMed Press, A unit of BSP books Pvt. Ltd, Hyderabad, 2011.
- 10.Khandelwal K. R. and Vrunda Sethi, Practical Pharmacognosy: Techniques and Experiments, Nirali Prakashan, 1994
- 11.Vasudevan T. N. Laddha K. S, Practical Pharmacognosy, New Vrinda Publishing House, Jalgaon, 1987.
- 12.Shah B.A., Seth A, Textbook of Pharmacognosy and Phytochemistry, 1st edition, Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd, New Delhi, 2010.

BP406P
MEDICINAL CHEMISTRY – I (Practical)

Course Objectives:

To get the learner introduced to the basic principles of organic synthesis

Course Outcomes

The learner should be able to:

1. Prepare simple organic compounds by following GLP and Safety practice
2. Conduct some simple assays for determination of quantitative estimation of some organic compounds

A. Preparation of drugs/ intermediates
1,3-pyrazole
1,3-oxazole
Benzimidazole
Benztriazole
2,3- diphenyl quinoxaline
Benzocaine
Phenytoin
Phenothiazine
Barbiturate
B. Assay of drugs
Chlorpromazine
Phenobarbitone
Atropine
Ibuprofen
Aspirin
Furosemide
C. Determination of Partition coefficient for any two drugs

Reference Books (Latest Editions to be adopted):

1. Beale J. M., Block J. H., Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceutical Chemistry, 20th edition, Lippincott Williams & Wilkins Publishers, 2004.
2. Lemke T. L., Williams D. A., Roche V. F., Zito., S. W., Foye's Principles of Medicinal Chemistry, 7th edition, Lippincott Williams and Wilkins Publishers, 2001
3. Abraham D. J., Burger's Medicinal Chemistry and Drug Discovery, Vol I to IV, 6th edition, John Wiley and Sons, Inc., Publication, 2003
4. Smith H. J., Smith and Williams' Introduction to Principles of Drug Design and Action, 4th edition, Taylor and Francis Publications, CRC Press, 2005
5. Remington, The Science and Practice of Pharmacy, 21st edition, Lippincott Williams and Wilkins Publication, 2005
6. Martindale: The Extra Pharmacopoeia, Pharmaceutical Press, 2008
7. Finar I. L., Organic Chemistry, Vol. II, 4th edition, Pearson Publishing House, Longman, 1963
8. Lednicer D., The Organic Chemistry of Drug Synthesis, Vol. 1-5, Wiley-Interscience, 2007
9. Indian Pharmacopoeia
10. Vogel A.I., Vogel's textbook of Practical Organic Chemistry, 5th edition, Pearson Publishing House, India, 1989

BP407P
PHYSICAL PHARMACEUTICS- II (Practical)

Course Objectives:

To familiarize the learner with methods to evaluate particle size, and flow properties, shelf life and physical stability of solutions and suspensions and teach the learner characterization methods and protocols for determination of physical parameters.

Course Outcomes

The learner should be able to:

1. Determine reaction rate constant, order of a reaction for different reactions
2. Predict shelf life by carrying out accelerated stability studies
3. Calculate physical parameters such as stability constants, particle size, density, flow properties, molecular weight, viscosity, and sedimentation rate.

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 and concentration of unknown 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 (Demonstration)
9	Determination of reaction rate constant first order and determine relative strength of acids.
10	Determination of reaction rate constant second order (both $a=b$ and $a \neq b$)
11	Accelerated stability studies and determination of shelf life
12	Determination of order of reaction using Ostwald Isolation Method (Demonstration)
13	Determination of molecular weight of a polymer using Intrinsic viscosity

Reference Books (Latest Editions to be adopted):

1. Martin A, Swarbrick. J, Cammarata A, Physical Pharmacy: Physical Chemical Principles in the Pharmaceutical Sciences, 3rd edition, BI Waverly. Pvt Ltd, New Delhi, 1993.
2. Sinko PJ, Singh Y. Martin's Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, 6th edition, Walter Kluwer, Philadelphia, 2011.
3. Parrott E.L, Saski W, Experimental Pharmaceutics, 4th edition, Burgess Publishing Company, Minneapolis, 1971
4. Carter S.J., Cooper and Gunn's. Tutorial Pharmacy, 6th edition, CBS Publications, New Delhi, 2005.
5. Stocklosa M. J. Pharmaceutical Calculations, 6th edition, Lea & Febiger, Philadelphia, 1974
6. Lieberman HA, Lachman L, Schwartz JB. Pharmaceutical dosage forms—tablets, Vol.1,2,3/edited by Herbert A. Lieberman, Leon Lachman, Joseph B. Schwartz, 2nd edition, Marcel Dekker Inc., New York, 1990.
7. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1, 2, 3/edited by Herbert A. Lieberman, Martin, M., and Gilbert S. Banker, 2nd edition, Marcel Dekker Inc. New York, 1998.
8. Ramasamy C, and Manavalan R, Physical Pharmaceutics, 1st edition, PharmaMed Press, 2017.

9. Bahl A, Bahl B. S, Tuli G. D, Essentials of Physical Chemistry, 28th edition, S Chand Publications, New Delhi, 2000.
10. C.V.S. Subrahmanyam , Textbook of Physical Pharmaceutics, 3rd edition, Vallabh Prakashan, Delhi, 2015
11. C.V.S. Subrahmanyam , Essentials of Physical Pharmaceutics, 2nd edition, Vallabh Prakashan, Delhi, 2017

BP408P
PHARMACOLOGY I (Practical)

Course Objectives

The course will impart training in basic laboratory techniques, instruments, and regulatory and ethical guidelines applicable in experimental pharmacology. The students will be appraised on animal handling techniques, routes of administration, anaesthesia and pharmacological effects of various drugs using simulated audio-visual techniques.

Course Outcomes:

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

1. Possess the knowledge of animals and instruments used pharmacology.
2. Relate to and apply the regulatory and ethical guidelines in drug/lead testing using preclinical animals.
3. Describe the animal handling techniques and procedures used in animal experimentation.
4. Observe the effect of drugs on animals by simulated experiments and interpret the pharmacological actions.

LIST OF EXPERIMENTS

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

Reference Books (Latest Editions to be adopted):

1. Ritter J. M., Flower R. J., Henderson G, Loke Y, MacEwan D, Rang H., Rang and Dale's Pharmacology, 9th edition, Elsevier Health, London 2019.
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and Clinical Pharmacology, 14th edition, Tata Mc Graw-Hill Education, Pvt. Ltd, 2017
3. Brunton, L.L., Hilal-Dandan R, Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics; 13th edition, McGraw-Hill Education, New York, 2017.
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. Zeind C.S., Carvahlo M.G., Applied Therapeutics: The Clinical Use of Drugs, 11th edition, Wolters Kluwer, Philadelphia, 2018
6. Harvey R, Clark MA, Finkel R., Rey, J.A., Whalen, K., Lippincott's Illustrated Reviews- Pharmacology, 5th edition, Wolter's Kruwer, 2011.
7. Tripathi K.D., Essentials of Medical Pharmacology, 8th edition, Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, 2019.
8. Sharma H. L., Sharma K. K., Principles of Pharmacology, 1st edition, Paras Medical Publisher, 2017.
9. Craig C.R., Stitzel, R.E, Modern Pharmacology with clinical Applications, 1st edition, Lippincott Williams and Wilkins, Philadelphia, 2004
10. Ghosh MN. Fundamentals of Experimental Pharmacology, 6th edition, Hilton & Company, Kolkata, 2015.
11. Kulkarni SK. Handbook of experimental pharmacology, 4th edition, Vallabh Prakashan, 2012.
12. Satoskar R.S. Bhandarkar S.D., Tripathi, R.K., Rege N. N., 25th edition, Pharmacology & Therapeutics, Elsevier co-published with Popular Prakashan, 2017.
13. Kasture, S. B., A handbook of Experiments in Pre-Clinical Pharmacology, 1st edition, Career Publications, Nasik, 2009.
14. Perry W. L. M., Pharmacological Experiments on isolated preparations, 1st edition, E & S Livingstone, Edinburg & London, 1968.

BP409P

PHARMACOGNOSY AND PHYTOCHEMISTRY I (Practical)

1. Analysis of crude drugs by chemical tests: (i) Tragacanth (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 palisade 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

Reference Books (Latest Editions to be adopted):

1. Evans W.C, Trease and Evans, Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E, Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Wallis T.E, Textbook of Pharmacognosy, J & A Churchill Ltd, London, 1946.
4. Mohammad Ali, Pharmacognosy and Phytochemistry, CBS Publishers & Distributors, New Delhi. 2018
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6. Choudhary R.D, Herbal Drug Industry, 1st edition, Eastern Publishers, New Delhi. 1996
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