DHANALAKSHMI SRINIVASAN
UNIVERSITY
Samayapuram, Tiruchirappalli – 621 112, Tamilnadu, India.

SYLLABUS

for

BACHELOR OF PHARMACY (B.Pharm)

DEGREE PROGRAM

[Credit Based Semester System]

(Effective from the Academic year 2024–2025)

B. PHARM (SEMESTER – I)		
BP101T	**HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)**	**45 Hours**
Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.		
COURSE OUTCOMES		
CO 1	Understand the structure and function of the human body at the molecular, cellular, tissue, and organ levels.	
CO 2	Explain the physiological processes of different organ systems.	
CO 3	Describe the organization and function of the skeletal, muscular, cardiovascular, and nervous systems.	
CO 4	Analyze the mechanisms that maintain homeostasis in the body.	
CO 5	Apply anatomical and physiological knowledge in clinical context.	
COURSE CONTENT		
Unit I	**Introduction to Human Body:** Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology. **Cellular level of Organization:** Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine **Tissue level of ORGANIZATION:** Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.	**10 hours**
Unit II	**Integumentary system:** Structure and functions of skin **Skeletal system:** Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system, Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction	**10 hours**

	Joints: Structural and functional classification, types of joints movements and its articulation	
Unit III	**Body fluids and blood:** Body fluids, composition and functions of blood, hemopoeisis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system. **Lymphatic system:** Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system.	**10 hours**
Unit IV	**Peripheral nervous system:** Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system. Origin and functions of spinal and cranial nerves. **Special senses**: Structure and functions of eye, ear, nose and tongue and their disorders.	**08 hours**
Unit V	**Cardiovascular system:** Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heartbeat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP107P	HUMAN ANATOMY AND PHYSIOLOGY (Practical)	4 Hours/Week
Scope: Practical physiology is complimentary to the theoretical discussions in physiology. Practical allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.		
1	Study of compound microscope	
2	Microscopic study of epithelial and connective tissue	
3	Microscopic study of muscular and nervous tissue	
4	Identification of axial bones	
5	Identification of appendicular bones	
6	Introduction to hemocytometry	
7	Enumeration of white blood cell (WBC) count	
8	Enumeration of total red blood corpuscles (RBC) count	
9	Determination of bleeding time	
10	Determination of clotting time	
11	Estimation of haemoglobin content	
12	Determination of blood group	
13	Determination of erythrocyte sedimentation rate (ESR)	
14	Determination of heart rate and pulse rate	
15	Recording of blood pressure	

BP102T	PHARMACEUTICAL ANALYSIS (Theory)	45 Hours
Scope: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs		
COURSE OUTCOMES		
CO 1	Minimize errors and enhance the accuracy and precision of analytical procedures.	
CO 2	Understand the principles of volumetric and electrochemical analysis.	
CO 3	Explain the various types of titrations used in pharmaceutical analysis.	
CO 4	Apply electrochemical techniques such as conductometry, potentiometry and polarography.	
CO 5	Apply analytical techniques to determine the quality and purity of pharmaceutical substances.	
COURSE CONTENT		
Unit I	**Pharmaceutical analysis**- Definition and scope a) Different techniques of analysis b) Methods of expressing concentration c) Primary and secondary standards. d) 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 **Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures. Pharmacopoeia, Sources of impurities in medicinal agents, limit tests.	**10 hours**
Unit II	**Acid base titration:** Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves **Non aqueous titration:** Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl	**10 hours**
Unit III	**Precipitation titrations:** Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride. **Complexometric titration:** Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.	**10 hours**

	Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate. Basic Principles, methods and application of diazotization titration.	
Unit IV	**Redox titrations** a) Concepts of oxidation and reduction b) Types of redox titrations (Principles and applications) Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate	**08 hours**
Unit V	**Electrochemical methods of analysis** **Conductometry**- Introduction, Conductivity cell, Conductometric titrations, applications. **Potentiometry** - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications. **Polarography** - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia

BP108P	PHARMACEUTICAL ANALYSIS (Practical)	4 Hours/Week

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

Section	Topic
I	**Limit Test of the following**
1	Chloride
2	Sulphate
3	Iron
4	Arsenic
II	**Preparation and standardization of**
1	Sodium hydroxide
2	Sulphuric acid
3	Sodium thiosulfate
4	Potassium permanganate
5	Ceric ammonium sulphate
III	**Assay of the following compounds along with Standardization of Titrant**
1	Ammonium chloride by acid base titration
2	Ferrous sulphate by Cerimetry
3	Copper sulphate by Iodometry
4	Calcium gluconate by Complexometry
5	Hydrogen peroxide by Permanganometry
6	Sodium benzoate by non-aqueous titration
7	Sodium Chloride by precipitation titration
IV	**Determination of Normality by electro-analytical methods**
1	Conductometric titration of strong acid against strong base
2	Conductometric titration of strong acid and weak acid against strong base
3	Potentiometric titration of strong acid against strong base

BP103T	PHARMACEUTICS- I (Theory)	45 Hours
Scope: This course is designed to impart a fundamental knowledge on the preparatory pharmacy with arts and science of preparing the different conventional dosage forms.		
COURSE OUTCOMES		
CO 1	Understand the basic concepts of pharmaceutics and dosage forms.	
CO 2	Explain the principles of various pharmaceutical formulations.	
CO 3	Analyze the factors affecting drug absorption, distribution, metabolism, and excretion.	
CO 4	Understand the manufacturing processes of different dosage forms.	
CO 5	Apply knowledge of pharmaceutics to design and evaluate pharmaceutical dosage forms.	
COURSE CONTENT		
Unit I	**Historical background and development of profession of pharmacy:** History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia. **Dosage forms:** Introduction to dosage forms, classification and definitions **Prescription:** Definition, Parts of prescription, handling of Prescription and Errors in prescription. **Posology:** Definition, Factors affecting posology. Pediatric dose calculations based on age, body weight and body surface area.	**10 hours**
Unit II	**Pharmaceutical calculations:** Weights and measures – Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight. **Powders:** Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions. **Liquid dosage forms:** Advantages and disadvantages of liquid dosage forms. Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques	**10 hours**

Unit III	**Monophasic liquids:** Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions. **Biphasic liquids:** **Suspensions:** Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome. **Emulsions**: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.	**10 hours**
Unit IV	**Suppositories:** Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories. **Pharmaceutical incompatibilities:** Definition, classification, physical, chemical and therapeutic incompatibilities with examples.	**08 hours**
Unit V	**Semisolid dosage forms:** Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. H.C. Ansel et al., pharmaceutical dosage form and drug delivery system, Lippincott Williams and Walkins, New Delhi.
2. Carter S.J., Cooper and Gunn's-Dispensing for pharmaceutical students, CBS publishers, New Delhi.
3. M.E. Aulton, Pharmaceutics, The science & dosage form design, Churchill Livingstone, Edinburgh.
4. Indian pharmacopoeia.
5. Lachmann, Theory and practice of industrial pharmacy, Lea & Febiger Publisher, The University of Michigan.
6. Alfonso R. Gennaro, Remington: The science and practice of pharmacy, Lippincott Williams, New Delhi.
7. Carter S.J., Cooper and Gunn's, Tutorial pharmacy, CBS Publications, New Delhi.
8. E.A. Rawlins, Bentley's text book of pharmaceutics, English Language Book Society, Elsevier Health Sciences, USA.
9. Isaac Ghebre Sellassie, Pharmaceutical pelletization technology, Marcel Dekker, INC, New York.
10. Dilip M. Parikh, Handbook of pharmaceutical granulation technology, Marcel Dekker, INC, New York.
11. Francoise Nieloud and Gilberte Marti-Mestres, Pharmaceutical emulsions and suspensions, Marcel Dekker, INC, New York.

BP109P	PHARMACEUTICS- I (Practical)	4 Hours/Week
S.No.	**Category**	a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68
1	**Syrups**	a) Piperazine citrate elixir b) Paracetamol pediatric elixir
2	**Elixirs**	a) Terpin Hydrate Linctus IP'66 b) Iodine Throat Paint (Mandles Paint)
3	**Linctus**	a) Strong solution of ammonium acetate b) Cresol with soap solution c) Lugol's solution
4	**Solutions**	a) Calamine lotion b) Magnesium Hydroxide mixture c) Aluminium Hydroxide gel
5	**Suspensions**	a) Turpentine Liniment b) Liquid paraffin emulsion
6	**Emulsions**	a) ORS powder (WHO) b) Effervescent granules c) Dusting powder d) Divided powders
7	**Powders and Granules**	a) Glycero gelatin suppository b) Cocoa butter suppository c) Zinc Oxide suppository
8	**Suppositories**	a) Sulphur ointment b) Non-staining-iodine ointment with methyl salicylate c) Carbopol gel
9	**Semisolids**	a) Iodine Gargle b) Chlorhexidine Mouthwash
10	**Gargles and mouthwashes**	a) Syrup IP'66 b) Compound syrup of Ferrous Phosphate BPC'68

BP104T	PHARMACEUTICAL INORGANIC CHEMISTRY (Theory)	45 Hours
Scope: This subject deals with the monographs of inorganic drugs and pharmaceuticals.		
COURSE OUTCOMES		
CO 1	Understand the classification, nomenclature, and properties of inorganic compounds.	
CO 2	Explain the preparation, uses, and analysis of various inorganic pharmaceutical compounds.	
CO 3	Analyse the importance of inorganic compounds in pharmacy and medicine.	
CO 4	Understand the concepts of qualitative and quantitative analysis of inorganic compounds.	
CO 5	Understand the principles and applications of radiopharmaceuticals in medical practice.	
COURSE CONTENT		
Unit I	**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 hours**
Unit II	**Acids, Bases and Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity. **Major extra and intracellular electrolytes:** Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance. **Dental products:** Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.	**10 hours**
Unit III	**Gastrointestinal agents** **Acidifiers:** Ammonium chloride* and Dil. HCl **Antacid:** Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture	**10 hours**

	Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite **Antimicrobials:** Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations	
Unit IV	**Miscellaneous compounds** **Expectorants:** Potassium iodide, Ammonium chloride*. Emetics: Copper sulphate*, Sodium potassium tartarate Haematinics: Ferrous sulphate*, Ferrous gluconate **Poison and Antidote:** Sodium thiosulphate*, Activated charcoal, Sodium nitrite333 **Astringents:** Zinc Sulphate, Potash Alum	**08 hours**
Unit V	**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.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

BP110P	PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)	4 Hours/Week

S.No.	Category	Experiment
1	**Limit tests for following ions**	a) Limit test for Chlorides and Sulphates b) Modified limit test for Chlorides and Sulphates c) Limit test for Iron d) Limit test for Heavy metals e) Limit test for Lead f) Limit test for Arsenic
2	**Identification test**	g) Magnesium hydroxide h) Ferrous sulphate i) Sodium bicarbonate j) Calcium gluconate k) Copper sulphate
3	**Test for purity**	l) Swelling power of Bentonite m) Neutralizing capacity of aluminium hydroxide gel n) Determination of potassium iodate and iodine in potassium iodide
4	**Preparation of inorganic pharmaceuticals**	o) Boric acid p) Potash alum q) Ferrous sulphate

BP105T	COMMUNICATION SKILLS (Theory)	30 Hours
Scope: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business.		
COURSE OUTCOMES		
CO 1	Understand the fundamentals of effective communication.	
CO 2	Explain the importance of communication in professional and personal contexts.	
CO 3	Develop skills in verbal and non-verbal communication.	
CO 4	Analyze various barriers to communication and strategies to overcome them.	
CO 5	Apply communication skills in pharmacy practice, including patient counselling and professional interactions.	
COURSE CONTENT		
Unit I	**Communication Skills**: Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment	**7 hours**
Unit II	**Elements of Communication:** Introduction, Face to Face Communication - Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication **Communication Styles:** Introduction, The Communication Styles Matrix with example for each -Direct Communication Style, Spirited Communication Style, Systematic Communication Style, Considerate Communication Style	**7 hours**
Unit III	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations	**7 hours**

	Effective Written Communication: Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion' Required, Shades of Meaning, Formal Communication **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message	
Unit IV	**Interview Skills:** Purpose of an interview, Do's and Dont's of an interview **Giving Presentations:** Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery	**5 hours**
Unit V	**Group Discussion:** Introduction, Communication skills in group discussion, Do's and Dont's of group discussion	**4 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition, Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1stEdition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1stEdition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1stEdition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, Gopala Swamy Ramesh, 5thEdition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Green hall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –
8. PHI, 2011
9. Personality development and soft skills, Barun K Mitra, 1stEdition, Oxford Press, 2011
10. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd, 2011
11. Soft skills and professional communication, Francis Peters SJ, 1stEdition, Mc Graw Hill Education, 2011
12. Effective communication, John Adair, 4thEdition, Pan Mac Millan,2009
13. Bringing out the best in people, Aubrey Daniels, 2ndEdition, Mc Graw Hill, 1999

BP111P	COMMUNICATION SKILLS (Practical)	2 Hours/Week

S.No.	Category	Experiment
1	**Basic Communication**	- Meeting People - Asking Questions - Making Friends - What did you do? - Do's and Don'ts
2	**Pronunciations**	- Pronunciation (Consonant Sounds) - Pronunciation and Nouns - Pronunciation (Vowel Sounds)
3	**Advanced Learning**	- Listening Comprehension / Direct and Indirect Speech - Figures of Speech - Effective Communication - Writing Skills - Effective Writing - Interview Handling Skills - E-Mail etiquette - Presentation Skills

BP106RBT	REMEDIAL BIOLOGY (Theory)	30 Hours
Scope: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.		
COURSE OUTCOMES		
CO 1	Understand the classification and key characteristics of the five kingdoms of life.	
CO 2	Comprehend the basic components and functions of plant and animal anatomy and physiology with a focus on human systems.	
CO 3	Gain knowledge of various human body systems, including circulatory, digestive, respiratory, excretory, nervous, endocrine and reproductive systems.	
CO 4	Understand plant nutrition, photosynthesis, respiration, growth and development.	
CO 5	Grasp the structure and function of cells and their organelles, as well as the types and functions of tissues and the process of cell division.	
COURSE CONTENT		
Unit I	**Living world:** Definition and characters of living organisms, Diversity in the living world, Binomial nomenclature, Five kingdoms of life and basis of classification. Salient features of Monera, Potista, Fungi, Animalia and Plantae, Virus, **Morphology of Flowering plants** Morphology of different parts of flowering plants – Root, stem, inflorescence, flower, leaf, fruit, seed. General Anatomy of Root, stem, leaf of monocotyledons & Dicotylidones.	**7 hours**
Unit II	**Body fluids and circulation** Composition of blood, blood groups, coagulation of blood; Composition and functions of lymph; Human circulatory system; Structure of human heart and blood vessels; Cardiac cycle, cardiac output and ECG **Digestion and Absorption** Human alimentary canal and digestive glands; Role of digestive enzymes; Digestion, absorption and assimilation of digested food; Breathing and respiration; Human respiratory system; Mechanism of breathing and its regulation; Exchange of gases, transport of gases and regulation of respiration; Respiratory volumes	**7 hours**

Unit III	**Excretory products and their elimination** Modes of excretion; Human excretory system- structure and function; Urine formation; Rennin angiotensin system **Neural control and coordination** Definition and classification of nervous system; Structure of a neuron; Generation and conduction of nerve impulse; Structure of brain and spinal cord; Functions of cerebrum, cerebellum, hypothalamus and medulla oblongata; **Chemical coordination and regulation** Endocrine glands and their secretions; Functions of hormones secreted by endocrine glands **Human reproduction** Parts of female reproductive system; Parts of male reproductive system; Spermatogenesis and Oogenesis; Menstrual cycle	**7 hours**
Unit IV	**Plants and mineral nutrition:** Essential mineral, macro and micronutrients; Nitrogen metabolism, Nitrogen cycle, biological nitrogen fixation **Photosynthesis** Autotrophic nutrition, photosynthesis, Photosynthetic pigments, Factors affecting photosynthesis.	**5 hours**
Unit V	**Plant respiration:** Respiration, glycolysis, fermentation (anaerobic). **Plant growth and development** Phases and rate of plant growth, Condition of growth, Introduction to plant growth regulators Cell - The unit of life Structure and functions of cell and cell organelles. Cell division **Tissues** Definition, types of tissues, location and functions.	**4 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

Text Books

1. Text book of Biology by S. B. Gokhale
2. A Text book of Biology by Dr. Thulajappa and Dr. Seetaram.

Reference Books

3. A Text book of Biology by B.V. Sreenivasa Naidu
4. A Text book of Biology by Naidu and Murthy
5. Botany for Degree students By A.C. Dutta.
6. Outlines of Zoology by M. Ekambaranatha ayyer and T. N. Ananthakrishnan.
7. A manual for pharmaceutical biology practical by S.B. Gokhale and C. K. Kokate

BP112RBP	REMEDIAL BIOLOGY (Practical)	30 Hours

S.No.	Category	Experiment
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	

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Practical human anatomy and physiology. by S.R. Kale and R.R. Kale.
2. A Manual of pharmaceutical biology practical by S.B. Gokhale, C.K. Kokate and S.P. Shriwastava.
3. Biology practical manual according to National core curriculum. Biology forum of Karnataka. Prof.M.J.H. Shafi

BP106RMT	REMEDIAL MATHEMATICS (Theory)	30 Hours
Scope: This is an introductory course in mathematics. This subject deals with the introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.		
COURSE OUTCOMES		
CO 1	Understand the fundamental concepts of mathematics relevant to pharmacy.	
CO 2	Explain the applications of calculus, algebra, and trigonometry in pharmaceutical sciences.	
CO 3	Analyze mathematical models used in pharmacokinetics and pharmacodynamics.	
CO 4	Solve mathematical problems related to drug formulation and dosing.	
CO 5	Apply mathematical principles in pharmaceutical research and practice.	
COURSE CONTENT		
Unit I	**Partial fraction** Introduction, Polynomial, Rational fractions, Proper and Improper fractions, Partial fraction, Resolving into Partial fraction, Application of Partial Fraction in Chemical Kinetics and Pharmacokinetics **Logarithms** Introduction, Definition, Theorems/Properties of logarithms, Common logarithms, Characteristic and Mantissa, worked examples, application of logarithm to solve pharmaceutical problems. **Function:** Real Valued function, Classification of real valued functions, Limits and continuity: Introduction, Limit of a function, Definition of limit of a function ($\in$ - δ definition), $\lim_{x\to a}\frac{x^n-a^n}{x-a}=na^{n-1}$, $\lim_{\theta\to 0}\frac{\sin\theta}{\theta}=1$,	**6 hours**
Unit II	**Matrices and Determinant:** Introduction matrices, Types of matrices, Operation on matrices, Transpose of a matrix, Matrix Multiplication, Determinants, Properties of determinants, Product of determinants, Minors and co-Factors, Adjoint or adjugate of a square matrix, Singular and non-singular matrices, Inverse of a matrix, Solution of system of linear of equations using matrix method, Cramer's rule, Characteristic equation and roots of a square matrix, Cayley–Hamilton theorem, Application of Matrices in solving Pharmacokinetic equations.	**6 hours**

Unit III	**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.tx, where n is any rational number, Derivative of ex,, Derivative of loge 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 hours**
Unit IV	**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 hours**
Unit V	**Differential Equations:** Some basic definitions, Order and degree, Equations in separable form, Homogeneous equations, Linear Differential equations, Exact equations, **Application in solving Pharmacokinetic equations** **Laplace Transform:** Introduction, Definition, Properties of Laplace transform, Laplace Transforms of elementary functions, Inverse Laplace transforms, Laplace transform of derivatives, Application to solve Linear differential equations, **Application in solving Chemical kinetics and Pharmacokinetics equations**	**6 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Differential Calculus by Shanthinarayan
2. Pharmaceutical Mathematics with application to Pharmacy by Panchaksharappa Gowda D.H.
3. Integral Calculus by Shanthinarayan
4. Higher Engineering Mathematics by Dr.B.S.Grewal

B. PHARM (SEMESTER – II)		
BP201T	**HUMAN ANATOMY AND PHYSIOLOGY-II (Theory)**	**45 Hours**
Scope: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.		
COURSE OUTCOMES		
CO 1	Understand the anatomy and physiology of various body systems including the nervous, endocrine, cardiovascular, respiratory, digestive, urinary, and reproductive systems.	
CO 2	Explain the biochemical and physiological processes underlying the function of different organs and systems.	
CO 3	Describe the mechanisms of homeostasis and how they maintain body equilibrium. Explain the introduction to genetics and discuss genetic pattern of inheritance	
CO 4	Analyze the physiological basis of health and disease states.	
CO 5	Apply knowledge of human anatomy and physiology in clinical contexts.	
COURSE CONTENT		
Unit I	**Nervous system** Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters. **Central nervous system:** Meninges, ventricles of brain and cerebrospinal fluid. Structure and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)	**10 hours**
Unit II	**Digestive system** Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT. **Energetics** Formation and role of ATP, Creatinine Phosphate and BMR.	**06 hours**

Unit III	**Respiratory system** Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods. **Urinary system** Anatomy of urinary tract with special reference to anatomy of kidney and nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.	**10 hours**
Unit IV	**Endocrine system** Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.	**10 hours**
Unit V	**Reproductive system** Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition **Introduction to genetics** Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance	**09 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP207P	HUMAN ANATOMY AND PHYSIOLOGY (Practical)	4 Hours/Week

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

S.No.	Topic
1	To study the integumentary and special senses using specimens, models, etc.
2	To study the nervous system using specimens, models, etc.
3	To study the endocrine system using specimens, models, etc.
4	To demonstrate the general neurological examination
5	To demonstrate the function of the olfactory nerve
6	To examine the different types of taste
7	To demonstrate visual acuity
8	To demonstrate reflex activity
9	Recording of body temperature
10	To demonstrate positive and negative feedback mechanisms
11	Determination of tidal volume and vital capacity
12	Study of digestive, respiratory, cardiovascular, urinary, and reproductive systems with models, charts, and specimens
13	Recording of basal metabolic index
14	Study of family planning devices and pregnancy diagnosis tests
15	Demonstration of total blood count by cell analyzer
16	Permanent slides of vital organs and gonads

BP202T	PHARMACEUTICAL ORGANIC CHEMISTRY –I (Theory)	45 Hours

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

COURSE OUTCOMES

CO 1	Gain foundational knowledge of organic chemistry concepts including classification, nomenclature, and isomerism.
CO 2	Explain the mechanisms of organic reactions, including electrophilic and nucleophilic substitution, elimination, and addition reactions.
CO 3	Analyse the various naming reactions and significance of qualitative tests in organic chemistry.
CO 4	Understand the synthesis and reactions of functional groups important in drug design and development.
CO 5	Apply organic chemistry principles to draw the structure and uses of organic compounds.

COURSE CONTENT

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

Unit I	**Classification, nomenclature and isomerism** Classification of Organic Compounds Common and IUPAC systems of nomenclature of organic compounds (up to 10 Carbons open chain and carbocyclic compounds); Structural isomerisms in organic compounds	**07 hours**
Unit II	**Alkanes*, Alkenes* and Conjugated dienes*** SP3 hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP2 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 hours**

Unit III	**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 ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform. **Alcohols*** Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol	**10 hours**
Unit IV	**Carbonyl compounds* (Aldehydes and ketones)** Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.	**10 hours**
Unit V	**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.	**09 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L. Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K. Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.
9. Reaction and reaction mechanism by Ahluwaliah/Chatwal.

BP208P	PHARMACEUTICAL ORGANIC CHEMISTRY -I (Practical)	4 Hours/Week
Systematic qualitative analysis of unknown organic compounds like		
1	Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.	
2	Detection of elements like Nitrogen, Sulphur & Halogen by Lassaigne's test	
3	Solubility test	
4	Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons, Nitro compounds and Anilides.	
5	Melting point/Boiling point of organic compounds	
6	Identification of the unknown compound from the literature using melting point/ boiling point.	
7	Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.	
8	Minimum 5 unknown organic compounds to be analysed systematically.	
Preparation of suitable solid derivatives from organic compounds		
Construction of molecular models		

BP203T	BIOCHEMISTRY (Theory)	45 Hours
Scope: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions.		
COURSE OUTCOMES		
CO 1	Understand the structure and function of biomolecules, including proteins, carbohydrates, lipids, and nucleic acids.	
CO 2	Explain the metabolic pathways and their regulation in the human body.	
CO 3	Understand the pathways and regulation of amino acid metabolism, lipid metabolism and their roles in health and disease.	
CO 4	Understand the pathways and regulatory mechanisms of nucleic acid metabolism, including DNA replication, transcription, and repair mechanisms.	
CO 5	Analyze the role of enzymes in catalyzing biochemical reactions.	
COURSE CONTENT		
Unit I	**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	**08 hours**
Unit II	**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 Hours**
Unit III	**Lipid metabolism**	**10 hours**

	β-Oxidation of saturated fatty acid (Palmitic acid) Formation and utilization of ketone bodies; ketoacidosis De novo synthesis of fatty acids (Palmitic acid) Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity. **Amino acid metabolism** General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenyketonuria, Albinism, alkeptonuria, tyrosinemia) Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline Catabolism of heme; hyperbilirubinemia and jaundice	
Unit IV	**Nucleic acid metabolism and genetic information transfer** Biosynthesis of purine and pyrimidine nucleotides; Catabolism of purine nucleotides and Hyperuricemia and Gout disease; Organization of mammalian genome; Structure of DNA and RNA and their functions; DNA replication (semi conservative model); Transcription or RNA synthesis; Genetic code, Translation or Protein synthesis and inhibitors	**10 hours**
Unit V	**Enzymes** Introduction, properties, nomenclature and IUB classification of enzymes; Enzyme kinetics (Michaelis plot, Line Weaver Burke plot); Enzyme inhibitors with examples; Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation Therapeutic and diagnostic applications of enzymes and isoenzymes; Coenzymes –Structure and biochemical functions	**09 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP209P	PHARMACEUTICAL BIOCHEMISTRY (Practical)	4 Hours/Week
S.No.	**Experiment**	
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	

BP204T	PATHOPHYSIOLOGY (THEORY)	45 Hours
Scope: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms.		
COURSE OUTCOMES		
CO 1	Understand the etiology, pathogenesis, and clinical manifestations of common diseases.	
CO 2	Explain the physiological and biochemical basis of disease processes.	
CO 3	Analyze the impact of diseases on various body systems.	
CO 4	Understand the principles of disease prevention and management.	
CO 5	Apply knowledge of pathophysiology in the context of drug therapy and clinical practice.	
COURSE CONTENT		
Unit I	**Basic principles of Cell injury and Adaptation:** Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance **Basic mechanism involved in the process of inflammation and repair:** Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis	**10 hours**
Unit II	**Cardiovascular System:** Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis) **Respiratory system:** Asthma, Chronic obstructive airways diseases. **Renal system:** Acute and chronic renal failure.	**10 hours**
Unit III	**Hematological Diseases:** Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalassemia, hereditary acquired anemia, hemophilia **Endocrine system:** Diabetes, thyroid diseases, disorders of sex hormones	**10 hours**

	Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders: depression, schizophrenia and Alzheimer's disease. **Gastrointestinal system:** Peptic Ulcer	
Unit IV	Inflammatory bowel diseases, jaundice, hepatitis (A, B, C, D, E, F) alcoholic liver disease. **Disease of bones and joints:** Rheumatoid arthritis, osteoporosis and gout **Principles of cancer:** Classification, etiology and pathogenesis of cancer **Diseases of bones and joints:** Rheumatoid Arthritis, Osteoporosis, Gout **Principles of Cancer:** Classification, etiology and pathogenesis of Cancer	**10 hours**
Unit V	**Infectious diseases:** Meningitis, Typhoid, Leprosy, Tuberculosis **Urinary tract infections:** Sexually transmitted diseases: AIDS, Syphilis, Gonorrhea	**09 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins &Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6 th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K.; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore;1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston; Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John. E Hall; Textbook of Medical Physiology; 12 th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9 th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6 th edition; Philadelphia; WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3 rd edition; London; Churchill Livingstone publication; 2003.

Recommended Journals

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

BP205T	COMPUTER APPLICATIONS IN PHARMACY (Theory)	30 Hrs (2 Hrs/Week)
Scope: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.		
COURSE OUTCOMES		
CO 1	Know the various types of computer applications used in the field of pharmacy.	
CO 2	Gain knowledge about different types of databases and database management systems.	
CO 3	Apply databases effectively in various aspects of pharmacy, including clinical studies and drug information management.	
CO 4	Understand web technologies, including HTML, XML, CSS, and server products, and their applications in pharmacy.	
CO 5	Use bioinformatics and data analysis tools in preclinical development, including chromatographic data analysis, Laboratory Information Management Systems (LIMS), and Text Information Management Systems (TIMS).	
COURSE CONTENT		
Unit I	**Number system:** Binary number system, Decimal number system, Octal number system, Hexadecimal number systems, conversion decimal to binary, binary to decimal, octal to binary etc, binary addition, binary subtraction – One's complement, Two's complement method, binary multiplication, binary division. **Concept of Information Systems and Software:** Information gathering, requirement and feasibility analysis, data flow diagrams, process specifications, input/output design, process life cycle, planning and managing the project	**06 hours**
Unit II	**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	**06 hours**
Unit III	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	**06 hours**

	Information System	
Unit IV	**Bioinformatics:** Introduction, Objective of Bioinformatics, Bioinformatics Databases, Concept of Bioinformatics, Impact of Bioinformatics in Vaccine Discovery	**06 hours**
Unit V	**Computers as data analysis in Preclinical development:** Chromatographic dada analysis (CDS), Laboratory Information management System (LIMS) and Text Information Management System (TIMS)	**06 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Computer Application in Pharmacy – William E. Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C. Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N. Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

BP210P	COMPUTER APPLICATIONS IN PHARMACY (Practical)	2 Hours/Week
S.No.	**Experiment**	
1	Design a questionnaire using a word processing package to gather information about a particular disease.	
2	Create a HTML web page to show personal information.	
3	Retrieve the information of a drug and its adverse effects using online tools.	
4	Creating mailing labels using Label Wizard, generating label in MS WORD.	
5	Create a database in MS Access to store the patient information with the required fields using Access.	
6	Design a form in MS Access to view, add, delete, and modify the patient record in the database.	
7	Generating report and printing the report from patient database.	
8	Creating invoice table using MS Access.	
9	Drug information storage and retrieval using MS Access.	
10	Creating and working with queries in MS Access.	
11	Exporting Tables, Queries, Forms, and Reports to web pages.	
12	Exporting Tables, Queries, Forms, and Reports to XML pages.	

BP206T	ENVIRONMENTAL SCIENCES (Theory)	30 Hrs
Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.		
COURSE OUTCOMES		
CO 1	Understand the various resources of environment and apply knowledge of environmental science to promote sustainable practices in pharmaceutical industries and healthcare.	
CO 2	Understand the principles of ecology and environmental science.	
CO 3	Analyze the effects of pollution on health and the environment.	
COURSE CONTENT		
Unit I	The Multidisciplinary nature of environmental studies Natural Resources Renewable and non-renewable resources: Natural resources and associated problems a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.	**10 hours**
Unit II	**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 hours**
Unit III	Environmental Pollution: Air pollution; Water pollution; Soil pollution	**10 hours**
RECOMMENDED BOOKS (LATEST EDITIONS)		
1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore 2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner. 3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India, 4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p 5. Clark R.S., Marine Pollution, Clanderson Press Oxford 6. De A.K., Environmental Chemistry, Wiley Eastern Ltd. 7. Down of Earth, Centre for Science and Environment		

B. PHARM (SEMESTER – III)		
BP301T	**PHARMACEUTICAL ORGANIC CHEMISTRY –II (Theory)**	**45 Hours**

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

COURSE OUTCOMES

CO 1	Understand the structural features of benzene and its derivatives, including aromaticity, resonance, and substitution reactions, and apply this knowledge to predict reactivity and orientation in electrophilic substitution reactions.
CO 2	Understand and apply analytical constants to characterize fats and oils, including acid value, saponification value, and iodine value.
CO 3	Valuate the structural and synthesis features contributing to their medicinal properties and apply this knowledge to pharmaceutical applications.
CO 4	Analyze the acidity of phenols and aromatic acids and evaluate the impact of substituents on their acidity. Apply qualitative tests to identify phenols and assess the structure-activity relationships for various phenolic compounds.
CO 5	Analyze how different groups affect the behavior of organic compounds, especially in aromatic and cycloalkane molecules.

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 difference

Unit I	**Benzene and its derivatives** a. Analytical, synthetic and other evidences in the derivation of structure of benzene, Orbital picture, resonance in benzene, aromatic characters, Huckel's rule b. Reactions of benzene - nitration, sulphonation, halogenation-reactivity, Friedelcrafts alkylation- reactivity, limitations, Friedelcrafts acylation. c. Substituents, effect of substituents on reactivity and orientation of mono substituted benzene compounds towards electrophilic substitution reaction d. Structure and uses of DDT, Saccharin, BHC and Chloramine	**10 hours**
Unit II	**Phenols*** - Acidity of phenols, effect of substituents on acidity, qualitative tests, Structure and uses of phenol, cresols, resorcinol,	**10 hours**

	naphthols **Aromatic Amines*** - Basicity of amines, effect of substituents on basicity, and synthetic uses of aryl diazonium salts **Aromatic Acids*** –Acidity, effect of substituents on acidity and important reactions of benzoic acid.	
Unit III	**Fats and Oils** a. Fatty acids – reactions. b. Hydrolysis, Hydrogenation, Saponification and Rancidity of oils, Drying oils. c. Analytical constants – Acid value, Saponification value, Ester value, Iodine value, Acetyl value, Reichert Meissl (RM) value – significance and principle involved in their determination.	**10 hours**
Unit IV	**Polynuclear hydrocarbons:** a. Synthesis, reactions b. Structure and medicinal uses of Naphthalene, Phenanthrene, Anthracene, Diphenylmethane, Triphenylmethane and their derivatives	**08 hours**
Unit V	**Cyclo alkanes*** Stabilities – Baeyer's strain theory, limitation of Baeyer's strain theory, Coulson and Moffitt's modification, Sachse Mohr's theory (Theory of strainless rings), reactions of cyclopropane and cyclobutane-only	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar, Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L. Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K. Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

BP305P	PHARMACEUTICAL ORGANIC CHEMISTRY -II (Practical)	4 Hrs/Week
Section	**Experiments**	
I	**Experiments involving laboratory techniques**	
	- Recrystallization	
	- Steam distillation	
II	**Determination of following oil values (including standardization of reagents)**	
	- Acid value	
	- Saponification value	
	- Iodine value	
III	**Preparation of compounds**	
	- Benzanilide/Phenyl benzoate/Acetanilide from Aniline/Phenol/Aniline by acylation reaction	
	- 2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/Acetanilide by halogenation (Bromination) reaction	
	- 5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid/Nitro benzene by nitration reaction	
	- Benzoic acid from Benzyl chloride by oxidation reaction	
	- Benzoic acid/Salicylic acid from alkyl benzoate/alkyl salicylate by hydrolysis reaction	
	- 1-Phenyl azo-2-napthol from Aniline by diazotization and coupling reactions	
	- Benzil from Benzoin by oxidation reaction	
	- Dibenzal acetone from Benzaldehyde by Claisen-Schmidt reaction	
	- Cinnamic acid from Benzaldehyde by Perkin reaction	
	- p-Iodo benzoic acid from p-Amino benzoic acid	

BP302T	PHYSICAL PHARMACEUTICS-I (Theory)	45 Hours
Scope: 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		
CO 1	Understand and apply the principles of drug solubility and the factors affecting it.	
CO 2	Describe and analyze the states and physicochemical properties of matter relevant to pharmaceuticals.	
CO 3	Understand and explain surface and interfacial phenomena, including measurement techniques and applications in pharmaceuticals.	
CO 4	Understand the principles of complexation and protein binding, their classifications, and their significance in drug action and stability.	
CO 5	Apply knowledge of pH, buffer systems, and isotonic solutions in pharmaceutical formulations and biological systems.	
COURSE CONTENT		
Unit I	**Solubility of drugs:** Solubility expressions, mechanisms of solute solvent interactions, ideal solubility parameters, solvation & association, quantitative approach to the factors influencing solubility of drugs, diffusion principles in biological systems. Solubility of gas in liquids, solubility of liquids in liquids, (Binary solutions, ideal solutions) Raoult's law, real solutions. Partially miscible liquids, Critical solution temperature and applications. Distribution law, its limitations and applications	**10 hours**
Unit II	**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. **Physicochemical properties of drug molecules:** Refractive index, optical rotation, dielectric constant, dipole moment, dissociation constant, determinations and applications	**10 hours**
Unit III	**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.	**08 hours**
Unit IV	**Complexation and protein binding:** Introduction, Classification of	**08 hours**

	Complexation, Applications, methods of analysis, protein binding, Complexation and drug action, crystalline structures of complexes and thermodynamic treatment of stability constants.	
Unit V	**pH, buffers and Isotonic solutions:** Sorensen's pH scale, pH determination (electrometric and calorimetric), applications of buffers, buffer equation, buffer capacity, buffers in pharmaceutical and biological systems, buffered isotonic solutions.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP306P	PHYSICAL PHARMACEUTICS – I (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Determination of the solubility of a drug at room temperature	
2	Determination of pKa value by Half Neutralization/Henderson-Hasselbalch equation	
3	Determination of partition coefficient of benzoic acid in benzene and water	
4	Determination of partition coefficient of iodine in CCl_4 and water	
5	Determination of % composition of NaCl in a solution using phenol-water system by CST method	
6	Determination of surface tension of given liquids by drop count and drop weight method	
7	Determination of HLB number of a surfactant by saponification method	
8	Determination of Freundlich and Langmuir constants using activated 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	

BP303T	PHARMACEUTICAL MICROBIOLOGY (Theory)	45 Hours
Scope: Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc..		
COURSE OUTCOMES		
CO 1	Understand the fundamentals of microbiology relevant to pharmaceutical sciences, including microbial structure, growth, and metabolism.	
CO 2	Analyze the role of microorganisms in pharmaceutical manufacturing, contamination control, and product stability assessment.	
CO 3	Discuss the principles and techniques of sterilization, disinfection, and microbial enumeration in pharmaceutical quality assurance.	
CO 4	Evaluate the microbiological quality of pharmaceutical raw materials, finished products, and manufacturing environments.	
CO 5	Apply microbiological concepts and techniques in the development and validation of aseptic processing and microbial control strategies.	
COURSE CONTENT		
Unit I	Introduction, history of microbiology, its branches, scope and its importance. Introduction to Prokaryotes and Eukaryotes Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count). Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.	**10 hours**
Unit II	Identification of bacteria using staining techniques (simple, Gram's &Acid-fast staining) and biochemical tests (IMViC). Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization. Evaluation of the efficiency of sterilization methods. Equipment's employed in large scale sterilization. Sterility indicators.	**10 hours**
Unit III	Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.	**10 hours**

Unit IV	Designing of aseptic area, laminar flow equipment's; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.	**08 hours**
Unit V	Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations. Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures. Application of cell cultures in pharmaceutical industry and research.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP307P	PHARMACEUTICAL MICROBIOLOGY (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Introduction and study of different equipment 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	Subculturing of bacteria and fungus. Nutrient stabs and slants preparations.	
4	Staining methods - Simple, Gram's staining, and acid-fast staining (Demonstration with practical).	
5	Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.	
6	Microbiological assay of antibiotics by cup plate method and other methods.	
7	Motility determination by hanging drop method.	
8	Sterility testing of pharmaceuticals.	
9	Bacteriological analysis of water.	
10	Biochemical tests.	

BP304T	PHARMACEUTICAL ENGINEERING (THEORY)	45 Hours
Scope: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.		
COURSE OUTCOMES		
CO 1	Understand fluid flow principles, size reduction mechanisms, and size separation techniques used in pharmaceutical processes.	
CO 2	Gain knowledge of heat transfer methods, evaporation processes, and distillation techniques essential for pharmaceutical manufacturing.	
CO 3	Comprehend drying and mixing principles and their applications in pharmaceutical production.	
CO 4	Understand filtration and centrifugation principles and their roles in pharmaceutical manufacturing.	
CO 5	Learn about materials selection for pharmaceutical plant construction, corrosion prevention methods, and basics of material handling systems.	
COURSE CONTENT		
Unit I	**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 Rotameter. **Size Reduction:** Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill. **Size Separation:** Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.	**10 hours**
Unit II	**Heat Transfer:** Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers. 82 • **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	**10 hours**
Unit III	**Drying:** Objectives, applications & mechanism of drying process,	**08 hours**

	measurements & applications of Equilibrium Moisture content, rate of drying curve. principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer. **Mixing:** Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier.	
Unit IV	**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.	**08 hours**
Unit V	**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 nonmetals, basic of material handling systems.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al., Latest
5. edition.
6. Remington practice of pharmacy- Martin, Latest edition.
7. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
8. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
9. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP308P	PHARMACEUTICAL ENGINEERING (Practical)	4 Hours/Week
S.No.	**Experiment**	
I	Determination of radiation constant of brass, iron, unpainted, and painted glass.	
II	Steam distillation – Calculation of the efficiency of steam distillation.	
III	Determination of the overall heat transfer coefficient by heat exchanger.	
IV	Construction of drying curves (for calcium carbonate and starch).	
V	Determination of moisture content and loss on drying.	
VI	Determination of humidity of air using wet and dry bulb temperatures, and Dew point method.	
VII	Description of construction, working, and application of Pharmaceutical Machinery (e.g., rotary tablet machine, fluidized bed coater, fluid energy mill, dehumidifier).	
VIII	Size analysis by sieving – Evaluation of size distribution of tablet granulations, construction of size frequency curves including arithmetic and logarithmic probability plots.	
IX	Size reduction: Verification of size reduction laws using ball mill, determination of Kicks, Rittinger's, Bond's coefficients, power requirement, and critical speed of Ball Mill.	
X	Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer, and other major equipment.	
XI	Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration, Thickness/viscosity).	
XII	Study of the effect of time on the Rate of Crystallization.	
XIII	Calculation of the uniformity index for a given sample using Double Cone Blender.	

B. PHARM (SEMESTER – IV)		
BP401T	**PHARMACEUTICAL ORGANIC CHEMISTRY –III (Theory)**	**45 Hours**
Scope: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.		
COURSE OUTCOMES		
CO 1	Demonstrate a thorough understanding of stereochemical aspects in organic compounds, including optical isomerism, geometrical isomerism, and conformational isomerism, enabling the interpretation of molecular structure and behaviour.	
CO 2	Analyse the mechanisms and stereochemistry of organic reactions relevant to the synthesis of medicinal compounds.	
CO 3	Discuss the principles of retrosynthetic analysis and multi-step synthesis strategies for complex organic molecules.	
CO 4	Evaluate the medicinal uses and other applications of organic compounds, with a focus on stereochemistry, recognizing the importance of chirality and spatial arrangement in drug design and other fields.	
CO 5	Apply knowledge of named reactions, including metal hydride reductions, oxidations, rearrangements, and other synthetic transformations, to design efficient synthetic routes for the preparation of complex organic molecules.	
COURSE CONTENT		
Note: To emphasize on definition, types, mechanisms, examples, uses/applications		
Unit I	**Stereo isomerism** Optical isomerism – Optical activity, enantiomerism, diastereoisomerism, meso compounds Elements of symmetry, chiral and achiral molecules, DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers, Reactions of chiral molecules, Racemic modification and resolution of racemic mixture, Asymmetric synthesis: partial and absolute.	**10 hours**
Unit II	Geometrical isomerism Nomenclature of geometrical isomers (Cis Trans, EZ, Syn Anti systems) Methods of determination of configuration of geometrical isomers. Conformational isomerism in Ethane, n-Butane and Cyclohexane. Stereo isomerism in biphenyl compounds (Atropoisomerism) and	**10 hours**

	conditions for optical activity. Stereospecific and stereoselective reactions	
Unit III	**Heterocyclic compounds:** Nomenclature and classification, Synthesis, reactions and medicinal uses of following compounds/derivatives Pyrrole, Furan, and Thiophene	**10 hours**
Unit IV	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.	**08 hours**
Unit V	**Reactions of synthetic importance** Metal hydride reduction (NaBH4 and LiAlH4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction. Oppenauer-oxidation and Dakin reaction. Beckmanns rearrangement and Schmidt rearrangement. Claisen-Schmidt condensation	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP402T	MEDICINAL CHEMISTRY – I (Theory)	45 Hours

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

COURSE OUTCOMES

CO 1	Demonstrate proficiency in writing the chemical synthesis of selected drugs, applying principles of organic chemistry to prepare pharmaceutical compounds efficiently and safely.
CO 2	Analyze the chemistry of drugs in relation to their pharmacological activity, including understanding the mechanisms of action and the influence of physicochemical properties on drug behavior.
CO 3	Evaluate drug metabolic pathways, recognizing potential adverse effects and assessing the therapeutic value of drugs in clinical settings, and understand the principles of drug metabolism, including Phase I and Phase II reactions.
CO 4	Evaluate the structure-activity relationships (SAR) of drugs and predict their pharmacological profiles using computational methods.
CO 5	Apply acquired knowledge to critically evaluate the development, classification, and uses of drugs covered in the course, integrating concepts of chemistry and pharmacology to understand their therapeutic applications.

COURSE CONTENT

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

Unit I	**Introduction to Medicinal Chemistry** **History and development of medicinal chemistry** **Physicochemical properties in relation to biological action** Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism. **Drug metabolism** Drug metabolism principles- Phase I and Phase II. Factors affecting drug metabolism including stereochemical aspects.	**10 hours**
Unit II	**Drugs acting on Autonomic Nervous System** **Adrenergic Neurotransmitters:** Biosynthesis and catabolism of catecholamine. Adrenergic receptors (Alpha & Beta) and their distribution.	**10 hours**

	Sympathomimetic agents: SAR of Sympathomimetic agents **Direct acting:** Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyldopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline, Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline. **Indirect-acting agents:** Hydroxy amphetamine, Pseudoephedrine, Propylhexedrine. **Agents with mixed mechanism:** Ephedrine, Metaraminol. **Adrenergic Antagonists:** **Alpha-adrenergic blockers:** Tolazoline*, Phentolamine, Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide. **Beta-adrenergic blockers:** SAR of beta blockers, Propranolol*, Metipranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetalol, Carvedilol.	
Unit III	**Cholinergic neurotransmitters:** **Biosynthesis and catabolism of acetylcholine.** Cholinergic receptors (Muscarinic & Nicotinic) and their distribution. **Parasympathomimetic agents: SAR of Parasympathomimetic agents** **Direct-acting agents:** Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine. **Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):** Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isofluorphate, Echothiopate iodide, Parathion, Malathion. **Cholinesterase reactivator:** Pralidoxime chloride. **Cholinergic Blocking agents: SAR of cholinolytic agents** Solanaceous alkaloids and analogs: Atropine sulfate, 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, Biperiden hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.	**10 hours**
Unit IV	**Drugs acting on Central Nervous System** **A. Sedatives and Hypnotics:** **Benzodiazepines:** SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Clorazepate, Lorazepam, Alprazolam,	**08 hours**

	Zolpidem **Barbiturates:** SAR of barbiturates, Barbital*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital **Miscellaneous:** Amides & imides: Glutethimide. Alcohol & their carbamate derivatives: Meprobamate, Ethchlorvynol. Aldehyde & their derivatives: Triclofos sodium, Paraldehyde. **B. 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 butyrophenones:** Haloperidol, Droperidol, Risperidone. Beta amino ketones: Molindone hydrochloride. **Benzamides:** Sulpieride. **C.Anticonvulsants:** SAR of Anticonvulsants, mechanism of anticonvulsant action **Barbiturates:** Phenobarbitone, Methabarbital. **Hydantoins:** Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:** Trimethadione, Paramethadione **Succinimides:** Phensuximide, Methsuximide, Ethosuximide* **Urea and monoacylureas:** Phenacemide, Carbamazepine* **Benzodiazepines:** Clonazepam **Miscellaneous:** Primidone, Valproic acid, Gabapentin, Felbamate	
Unit V	**Drugs acting on Central Nervous System** **General anesthetics:** **Inhalation anesthetics:** Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane. **Ultra short-acting barbiturates:** Methohexital sodium*, Thiamylal sodium, Thiopental sodium. **Dissociative anesthetics:** Ketamine hydrochloride. * **Narcotic and non-narcotic analgesics** **Morphine and related drugs:** SAR of Morphine analogs, Morphine sulphate, Codeine, Meperidine hydrochloride, Anilerdine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate. **Narcotic antagonists:** Nalorphine hydrochloride, Levallorphan	**07 hours**

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

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP406P	**MEDICINAL CHEMISTRY – I (Practical)**	**4 Hours/Week**
Category	**Experiment**	
I.	**Preparation of Drugs/Intermediates**	
	1. 1,3-pyrazole	
	2. 1,3-oxazole	
	3. Benzimidazole	
	4. Benztriazole	
	5. 2,3-diphenyl quinoxaline	
	6. Benzocaine	
	7. Phenytoin	
	8. Phenothiazine	
	9. Barbiturate	
II.	**Assay of Drugs**	
	1. Chlorpromazine	
	2. Phenobarbitone	
	3. Atropine	
	4. Ibuprofen	
	5. Aspirin	
	6. Furosemide	
III.	**Determination of Partition Coefficient for Any Two Drugs**	

BP403T	PHYSICAL PHARMACEUTICS-II (Theory)	45 Hours
Scope: The course deals with the various physica and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.		
COURSE OUTCOMES		
CO 1	Understand the classification and properties of colloidal dispersions, including their stability influenced by electrolytes and protective agents.	
CO 2	Gain knowledge of rheological principles it's applications on pharmaceuticals.	
CO 3	Learn about the formulation principles and properties of emulsions and suspensions.	
CO 4	Understand the fundamental and derived properties of particles.	
CO 5	Learn reaction kinetics, factors affecting drug degradation, methods for stabilization against common reactions, accelerated stability testing, and prevention of photolytic degradation in drug stability.	
COURSE CONTENT		
Unit I	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.	**07 hours**
Unit II	**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	**10 hours**
Unit III	**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.	**10 hours**
Unit IV	**Micromeretics**: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.	**10 hours**

Unit V	**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 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Physical Pharmacy by Alfred Martin, Sixth edition
2. Experimental pharmaceutics by Eugene, Parott.
3. Tutorial pharmacy by Cooper & Gunn.
4. Stocklosam J. Pharmaceutical calculations, Lea & Febiger, Philadelphia.
5. Liberman H.A, Lachman C., Pharmaceutical Dosage forms, Tablets, Volume-1 to 3, Marcel Dekkar Inc.
6. Liberman H.A, Lachman C, Pharmaceutical dosage forms. Disperse systems, volume 1,2,3Marcel Dekkar Inc.
7. Physical Pharmaceutics by Ramasamy C, and Manavalan R.

BP407P	**PHYSICAL PHARMACEUTICS- II (Practical)**	**4 Hours/Week**
S.No.	**Experiment**	
1	Determination of particle size, particle size distribution using sieving method	
2	Determination of particle size, particle size distribution using microscopic method	
3	Determination of bulk density, true density and porosity	
4	Determine the angle of repose and influence of lubricant on angle of repose	
5	Determination of viscosity of liquid using Ostwald's viscometer	
6	Determination sedimentation volume with effect of different suspending agent	
7	Determination sedimentation volume with effect of different concentration of single suspending agent	
8	Determination of viscosity of semisolid by using Brookfield viscometer	
9	Determination of reaction rate constant first order	
10	Determination of reaction rate constant second order	
11	Accelerated stability studies	

BP404T	PHARMACOLOGY-I (THEORY)	45 Hours
Scope: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.		
COURSE OUTCOMES		
CO 1	Understand the basic principles of pharmacology and their application in the study of drug actions and interactions in biological systems.	
CO 2	Analyze the pharmacodynamics and pharmacokinetics of drugs, including their absorption, distribution, metabolism, and excretion (ADME).	
CO 3	Discuss the mechanisms of drug-receptor interactions, enzyme inhibition, and signal transduction pathways involved in pharmacological responses.	
CO 4	Evaluate the pharmacological effects and therapeutic uses of drugs acting on the autonomic nervous system, central nervous system, and other targets.	
CO 5	Apply pharmacological principles in the rational selection and optimization of drug therapy regimens for specific disease conditions.	
COURSE CONTENT		
Unit I	**1. General Pharmacology** a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists (competitive and non-competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy. b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs. Enzyme induction, enzyme inhibition, kinetics of elimination	**08 hours**
Unit II	**General Pharmacology** c. 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. d. Adverse drug reactions.	**12 hours**

	e. Drug interactions (pharmacokinetic and pharmacodynamic) f. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.	
Unit III	**Pharmacology of drugs acting on peripheral nervous system** a. Organization and function of ANS. b. Neurohumoral transmission-transmission and classification of neurotransmitters. c. Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics. d. Neuromuscular blocking agents and skeletal muscle relaxants (peripheral). e. Local anesthetic agents. f. Drugs used in myasthenia gravis and glaucoma	**10 hours**
Unit IV	**Pharmacology of drugs acting on central nervous system** a. Neurohumoral transmission in the C.N.S. special emphasis on importance of various b. neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine. b. General anesthetics and pre-anesthetics. c. Sedatives, hypnotics and centrally acting muscle relaxants. d. Anti-epileptics; Alcohols and disulfiram	**08 hours**
Unit V	**Pharmacology of drugs acting on central nervous system** a. Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens. b. Drugs used in Parkinsons disease and Alzheimer's disease. c. CNS stimulants and nootropics. d. Opioid analgesics and antagonists e. Drug addiction, drug abuse, tolerance and dependence.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Introduction to chemical engineering – Walter L Badger & Julius Banchero, Latest
2. edition.
3. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson-Latest edition.
4. Unit operation of chemical engineering – Mcabe Smith, Latest edition.
5. Pharmaceutical engineering principles and practices – C.V.S Subrahmanyam et al.,
6. Remington practice of pharmacy- Martin, Latest edition.
7. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
8. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
9. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP408P	PHARMACOLOGY-I (Practical)	4 Hours/Week
S.No.	**Experiment**	
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	
6	Study of different routes of drug administration in mice/rats	
7	Effect of hepatic microsomal enzyme inducers on phenobarbitone sleeping time	
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	
14	Study of anxiolytic activity of drugs using rats/mice	
15	Study of local anaesthetics by different methods	

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

BP405T	PHARMACOGNOSY AND PHYTOCHEMISTRY I (Theory)	45 Hours
Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.		
COURSE OUTCOMES		
CO 1	Acquire comprehensive knowledge of the principles and methods used in the evaluation of crude drugs, including botanical identification, phytochemical analysis, and pharmacological testing.	
CO 2	Understand the principles and methods of cultivating and collecting herbal plants, including best agricultural practices and sustainable harvesting techniques.	
CO 3	Comprehend the fundamental principles and techniques of plant tissue culture, including micropropagation, somatic embryogenesis, and organogenesis.	
CO 4	Gain comprehensive knowledge of various alternative systems of medicine, including their philosophies, principles, and therapeutic approaches.	
CO 5	Evaluate the pharmacological properties and therapeutic potential of medicinal plants and their derived phytoconstituents	
COURSE CONTENT		
Unit I	**Introduction to Pharmacognosy:** (a) Definition, history, scope and development of Pharmacognosy (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins). **Classification of drugs:** Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs **Quality control of Drugs of Natural Origin:** Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties. Quantitative microscopy of crude drugs including lycopodium spore method, leafconstants, camera lucida and diagrams of microscopic objects to scale with camera lucida.	**10 hours**
Unit II	**Cultivation, Collection, Processing and storage of drugs of natural origin:** Cultivation and Collection of drugs of natural origin Factors influencing cultivation of medicinal plants. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants **Conservation of medicinal plants**	**10 hours**
Unit III	**Plant tissue culture:** Historical development of plant tissue	**07 hours**

	culture, types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in pharmacognosy. Edible vaccines	
Unit IV	**Pharmacognosy in various systems of medicine:** Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine. **Introduction to secondary metabolites:** Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins	**10 hours**
Unit V	Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs **Plant Products:** Fibers - Cotton, Jute, Hemp Hallucinogens, Teratogens, Natural allergens **Primary metabolites:** General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as Pharmaceutical Aids and/or Medicines for the following Primary metabolites: **Carbohydrates:** Acacia, Agar, Tragacanth, Honey Proteins and **Enzymes:** Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin). **Lipids (Waxes, fats, fixed oils):** Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax Marine Drugs: Novel medicinal agents from marine sources	**08 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs by M.A. IyengarCooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

BP409P	Pharmacognosy and Phytochemistry I – (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Analysis of crude drugs by chemical tests	
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	
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	

BP501T	MEDICINAL CHEMISTRY – II (Theory)	45 Hours

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

COURSE OUTCOMES

CO 1	Analyze the chemical structures of various classes of drugs.
CO 2	Understand the mechanisms of action and SAR of medicinal compounds.
CO 3	Evaluate the pharmacokinetic properties and metabolism of drugs.
CO 4	Explain the synthesis and design of new drug molecules.
CO 5	Apply knowledge of medicinal chemistry in drug discovery processes.

COURSE CONTENT

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

Unit I	**Antihistaminic agents:** Histamine, receptors and their distribution in the human body **H1–antagonists:** Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines cuccinate, Clemastine fumarate, Diphenylphyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetrazine Cromolyn sodium **H2-antagonists:** Cimetidine*, Famotidine, Ranitidin. **Gastric Proton pump inhibitors:** Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole **Anti-neoplastic agents:** **Alkylating agents:** Meclorethamine*, Cyclophosphamide Melphalan, Chlorambucil, Busulfan, Thiotepa **Antimetabolites:** Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine **Antibiotics:** Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin Plant **products:** Etoposide, Vinblastin sulphate, Vincristin sulphate **Miscellaneous:** Cisplatin, Mitotane.	**10 hours**
Unit II	**Anti-anginal: Vasodilators:** Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole. **Calcium channel blockers:** Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine. **Diuretics: Carbonic anhydrase inhibitors:** Acetazolamide*, Methazolamide, Dichlorphenamide. **Thiazides:** Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide, **Loop diuretics:** Furosemide*, Bumetanide, Ethacrynic acid. Potassium sparing Diuretics: Spironolactone, Triamterene,	**10 hours**

	Amiloride. **Osmotic Diuretics:** Mannitol **Anti-hypertensive Agents:** Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride, * Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride	
Unit III	**Anti-arrhythmic Drugs:** Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcainide hydrochloride, Amiodarone, Sotalol. **Anti-hyperlipidemic agents:** Clofibrate, Lovastatin, Cholesteramine and Cholestipol **Coagulant & Anticoagulants:** Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel **Congestive Heart Failure:** Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.	**10 hours**
Unit IV	**Drugs acting on Endocrine system:** Nomenclature, Stereochemistry and metabolism of steroids **Sex hormones:** Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol. **Drugs for erectile dysfunction:** Sildenafil, Tadalafil. **Oral contraceptives:** Mifepristone, Norgestril, Levonorgestrol **Corticosteroids:** Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone **Thyroid and antithyroid drugs:** L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.	**08 hours**
Unit V	**Antidiabetic agents:** Insulin and its preparations **Sulfonyl ureas:** Tolbutamide*, Chlorpropamide, Glipizide, Glimepiride. Biguanides: Metformin. **Thiazolidinediones:** Pioglitazone, Rosiglitazone. **Meglitinides:** Repaglinide, Nateglinide. **Glucosidase inhibitors:** Acrabose, Voglibose. **Local Anesthetics:** SAR of Local anesthetics Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine. **Amino Benzoic acid derivatives:** Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate. **Lidocaine/Anilide derivatives:** Lignocaine, Mepivacaine, Prilocaine, Etidocaine. **Miscellaneous:** Phenacaine, Diperodon, Dibucaine. *	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP 502 T	Industrial Pharmacy I (Theory)	45 Hours
Scope: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.		
COURSE OUTCOMES		
CO 1	Understand and apply preformulation principles to evaluate drug properties for predicting formulation challenges and ensuring stability.	
CO 2	Formulate, manufacture, and perform quality control on tablets and liquid orals, understanding their production processes and challenges.	
CO 3	Understand production processes and quality control for hard and soft gelatin capsules and the formulation and manufacturing of pellets.	
CO 4	Gain knowledge in the formulation, production, and quality control of parenteral and ophthalmic products, focusing on aseptic processing and stability.	
CO 5	Formulate and prepare cosmetic products and pharmaceutical aerosols, and understand packaging materials science and quality control for product stability and safety.	
COURSE CONTENT		
Unit I	**Preformulation Studies:** Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances. **Physical properties:** Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism **Chemical Properties:** Hydrolysis, oxidation, reduction, racemization, polymerization BCS classification of drugs & its significant Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.	**07 hours**
Unit II	**Tablets:** Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. **Tablet coating:** Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. **Quality control tests:** In process and finished product tests **Liquid orals:** Formulation and manufacturing consideration of syrups and elixirs suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia	**10 hours**
Unit III	**Capsules:** **Hard gelatin capsules:** Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules. **Soft gelatin capsules:** Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.	**08 hours**

	Pellets: Introduction, formulation requirements, pelletization process, Equipments for manufacture of pellets	
Unit IV	**Parenteral Products:** Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity Production procedure, production facilities and controls, aseptic processing. Formulation of injections, sterile powders, large volume parenteral and lyophilized products. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products. **Ophthalmic Preparations:** Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labeling, containers; evaluation of ophthalmic preparations	**10 hours**
Unit V	**Cosmetics:** Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens. **Pharmaceutical Aerosols:** Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies. **Packaging Materials Science:** Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests.	**10 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman&J.B. Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman &Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition PharmaceuticalScience (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E. Aulton, Churchilllivingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea &Febiger,Philadelphia, 5thedition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition,Marcel Dekker Series, Vol 107.

BP502P	Industrial Pharmacy I (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Preformulation studies on Paracetamol/Aspirin/or any other drug	
2	Preparation and evaluation of Paracetamol tablets	
3	Preparation and evaluation of Aspirin tablets	
4	Coating of tablets- film coating of tables/granules	
5	Preparation and evaluation of Tetracycline capsules	
6	Preparation of Calcium Gluconate injection	
7	Preparation of Ascorbic Acid injection	
8	Quality control test of (as per IP) marketed tablets and capsules	
9	Preparation of Eye drops and Eye ointments	
10	Preparation of Creams (Cold / Vanishing cream)	
11	Evaluation of Glass containers (as per IP)	

BP503T	PHARMACOLOGY-II (Theory)	45 Hours

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

COURSE OUTCOMES

CO 1	Understand the mechanisms of drug action on various physiological systems.
CO 2	Analyze the pharmacological effects and therapeutic uses of drugs.
CO 3	Evaluate the adverse effects and toxicity profiles of pharmacological agents.
CO 4	Explain the principles of bioassay and its application in assaying varying drugs.
CO 5	Apply pharmacological concepts in clinical practice and drug therapy.

COURSE CONTENT

Unit I	**1. Pharmacology of drugs acting on cardio vascular system** a. Introduction to hemodynamic & electrophysiology of heart. b. Drugs used in congestive heart failure c. Anti-hypertensive drugs. d. Anti-anginal drugs. e. Anti-arrhythmic drugs. f. f. Anti-hyperlipidemic drugs.	**08 hours**
Unit II	**1. Pharmacology of drugs acting on cardio vascular system** a. Drug used in the therapy of shock. b. Hematinics, coagulants and anticoagulants. c. Fibrinolytics and anti-platelet drugs d. Plasma volume expanders **2. Pharmacology of drugs acting on urinary system** a. Diuretics b. Anti-diuretics.	**12 hours**
Unit III	**Autocoids and related drugs** a. Introduction to autacoids and classification b. Histamine, 5-HT and their antagonists. c. Prostaglandins, Thromboxanes and Leukotrienes. d. Angiotensin, Bradykinin and Substance P. e. Non-steroidal anti-inflammatory agents f. Anti-gout drugs a. Antirheumatic drugs	**10 hours**
Unit IV	**Pharmacology of drugs acting on endocrine system** a. Basic concepts in endocrine pharmacology. b. Anterior Pituitary hormones- analogues and their inhibitors. c. Thyroid hormones- analogues and their inhibitors. d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D. e. Insulin, Oral Hypoglycemic agents and glucagon. f. ACTH and corticosteroids.	**08 hours**

Unit V	**Pharmacology of drugs acting on endocrine system** a. Androgens and Anabolic steroids. b. Estrogens, progesterone and oral contraceptives. c. Drugs acting on the uterus. **6. Bioassay** a. Principles and applications of bioassay. b. Types of bioassay c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A.
5. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point
6. Lippincott Williams & Wilkins.
7. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews- Pharmacology.
8. K.D. Tripathi. Essentials of Medical Pharmacology, JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
9. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
10. Modern Pharmacology with clinical Applications, by Charles R. Craig& Robert.
11. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
12. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan.

BP507P	PHARMACOLOGY-I (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Introduction to in-vitro pharmacology and physiological salt solutions	
2	Effect of drugs on isolated frog heart	
3	Effect of drugs on blood pressure and heart rate of dog	
4	Study of diuretic activity of drugs using rats/mice	
5	DRC of acetylcholine using frog rectus abdominis muscle	
6	Effect of physostigmine and atropine on DRC of acetylcholine	
7	Bioassay of histamine using guinea pig ileum by matching method	
8	Bioassay of oxytocin using rat uterine horn by interpolation method	
9	Bioassay of serotonin using rat fundus strip by three-point bioassay	
10	Bioassay of acetylcholine using rat ileum/colon by four-point bioassay	
11	Determination of PA2 value of prazosin using rat anococcygeus muscle (by Schilds plot method)	
12	Determination of PD2 value using guinea pig ileum	
13	Effect of spasmogens and spasmolytics using rabbit jejunum	
14	Anti-inflammatory activity of drugs using carrageenan induced paw-edema model	
15	Analgesic activity of drug using central and peripheral methods	

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

BP504T	PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)	45 Hours
Scope: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.		
COURSE OUTCOMES		
CO 1	Gain in-depth knowledge of the metabolic pathways involved in higher plants, including photosynthesis, respiration, and secondary metabolite biosynthesis.	
CO 2	Understand the therapeutic applications of secondary metabolites, including their roles in traditional and modern medicine. Learn about their pharmacological properties and Commercial applications.	
CO 3	Acquire a knowledge of phytoconstituents, their types, and their roles in plants, including alkaloids, flavonoids, terpenoids, glycosides, and phenolics.	
CO 4	Apply techniques for the extraction, isolation, and characterization of bioactive compounds.	
CO 5	Gain a solid understanding of the basic principles of phytochemistry, including the study of bioactive compounds in plants and their chemical properties.	
COURSE CONTENT		
Unit I	**Metabolic pathways in higher plants and their determination** a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway. b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies	**07 hours**
Unit II	**General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:** **Alkaloids:** Vinca, Rauwolfia, Belladonna, Opium, **Phenylpropanoids and Flavonoids:** Lignans, Tea, Ruta Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis **Volatile oils**: Mentha, Clove, Cinnamon, Fennel, Coriander, Tannins: Catechu, Pterocarpus **Resins:** Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony **Glycosides: S**enna, Aloes, Bitter Almond **Iridoids, Other terpenoids & Naphthaquinones:** Gentian, Artemisia, taxus, carotenoids	**14 hours**
Unit III	**Isolation, Identification and Analysis of Phytoconstituents** a) Terpenoids: Menthol, Citral, Artemisin b) Glycosides: Glycyrhetinic acid & Rutin c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine	**06 hours**

	d) Resins: Podophyllotoxin, Curcumin	
Unit IV	Industrial production, estimation and utilization of the following phytoconstituents: Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine	**10 hours**
Unit V	**Basics of Phytochemistry** Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.	**08 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. W.C. Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Sounders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H. Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours. 11. Remington's Pharmaceutical sciences. 12. Text Book of Biotechnology by Vyas and Dixit.
11. Text Book of Biotechnology by R.C. Dubey

BP508P	Pharmacognosy and Phytochemistry II – (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	Morphology, histology, and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel, and Coriander	
2	Exercise involving isolation & detection of active principles: Caffeine from tea dust Diosgenin from Dioscorea Atropine from Belladonna Sennosides from Senna	
3	Separation of sugars by Paper chromatography	
4	TLC of herbal extract	
5	Distillation of volatile oils and detection of phytoconstituents by TLC	
6	Analysis of crude drugs by chemical tests: Asafoetida, Benzoin, Colophony, Aloes, Myrrh	

B. PHARM (SEMESTER – VI)		
BP601T	**MEDICINAL CHEMISTRY-III (Theory)**	**45 Hours**

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

COURSE OUTCOMES

CO 1	Analyze advanced chemical structures of medicinal compounds.
CO 2	Understand drug design principles for specific therapeutic targets.
CO 3	Evaluate the chemical classes and mechanism of action of drugs.
CO 4	Explain the structure-activity relationships (SAR) in drug discovery.
CO 5	Apply computational methods in medicinal chemistry research.

COURSE CONTENT

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

Unit I	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification and important products of the following classes. **β-Lactam antibiotics:** Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams **Aminoglycosides:** Streptomycin, Neomycin, Kanamycin **Tetracyclines:** Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline	**10 hours**
Unit II	**Antibiotics** Historical background, Nomenclature, Stereochemistry, Structure-activity relationship, Chemical degradation classification and important products of the following classes. **Macrolide**: Erythromycin Clarithromycin, Azithromycin. **Miscellaneous**: Chloramphenicol*, Clindamycin. **Prodrugs**: Basic concepts and application of prodrugs design.	**10 hours**

	Antimalarials: Etiology of malaria. **Quinolines**: SAR, Quinine sulfate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine. **Biguanides and dihydro triazines:** Cycloguanil pamoate, Proguanil. **Miscellaneous**: Pyrimethamine, Artesunate, Artemether, Atovaquone.	
Unit III	**Anti-tubercular Agents** **Synthetic anti-tubercular agents:** Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid. * **Anti-tubercular antibiotics:** Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulfate. **Urinary tract anti-infective agents** **Quinolones:** SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin **Miscellaneous:** Furazolidone, Nitrofurantoin*, Methenamine. **Antiviral agents:** Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Ganciclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirdine, Ribavirin, Saquinavir, Indinavir, Ritonavir.	**10 hours**
Unit IV	**Antifungal agents:** **Antifungal antibiotics:** Amphotericin-B, Nystatin, Natamycin, Griseofulvin. **Synthetic Antifungal agents:** Clotrimazole, Econazole, Butoconazole, Oxiconazole Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*. **Anti-protozoal Agents:** Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine. **Anthelmintics:** Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantel, Ivermectin. **Sulphonamides and Sulfones** Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mafenide acetate, Sulfasalazine. **Folate reductase inhibitors:** Trimethoprim*, Cotrimoxazole. **Sulfones**: Dapsone*.	**08 hours**

Unit V	**Introduction to Drug Design** Various approaches used in drug design. Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammet's electronic parameter, Tafts steric parameter and Hansch analysis. **Pharmacophore modelling and docking techniques.** **Combinatorial Chemistry:** Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP607P	MEDICINAL CHEMISTRY-III (Practical)	4 Hours/Week

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

S.No.	Topic
I.	**Preparation of drugs and intermediates**
1	Sulphanilamide
2	7-Hydroxy, 4-methyl coumarin
3	Chlorobutanol
4	Triphenyl imidazole
5	Tolbutamide
6	Hexamine
II.	**Assay of drugs**
1	Isonicotinic acid hydrazide
2	Chloroquine
3	Metronidazole
4	Dapsone
5	Chlorpheniramine maleate
6	Benzylpenicillin
III.	**Preparation of medicinally important compounds or intermediates microwave irradiation technique**
IV.	**Drawing structures and reactions using chem draw®**
V.	**Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeliness screening (Lipinskies RO5)**

BP602T	PHARMACOLOGY-III (Theory)	45 Hours
Scope: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on the respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology and in addition, emphasis on the principles of toxicology and chronopharmacology.		
COURSE OUTCOMES		
CO 1	Analyze the mechanisms of action of advanced pharmacological agents.	
CO 2	Understand the pharmacodynamics and pharmacokinetics of drugs.	
CO 3	Evaluate the therapeutic uses and adverse effects of pharmacological agents.	
CO 4	Explain the principles of chronopharmacology and immunopharmacology	
CO 5	Apply pharmacological concepts in the treatment of complex diseases.	
COURSE CONTENT		
Unit I	**1. Pharmacology of drugs acting on Respiratory system** a. Anti -asthmatic drugs b. Drugs used in the management of COPD c. Expectorants and antitussives d. Nasal decongestants e. Respiratory stimulants **2. Pharmacology of drugs acting on the Gastrointestinal Tract** a. Antiulcer agents. b. Drugs for constipation and diarrhoea. c. Appetite stimulants and suppressants. d. Digestants and carminatives. e. Emetics and anti-emetics.	**10 hours**
Unit II	**3. Chemotherapy** a. General principles of chemotherapy. b. Sulfonamides and cotrimoxazole. c.Antibiotics- Penicillin's, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides	**10 hours**
Unit III	**3. Chemotherapy** a. Antitubercular agents b. Antileprotic agents c. Antifungal agents d. Antiviral drugs e. Anthelmintics	**10 hours**

	f. Antimalarial drugs g. Antiamoebic agents	
Unit IV	**3. Chemotherapy** Urinary tract infections and sexually transmitted diseases. Chemotherapy of malignancy. **4. Immunopharmacology** a. Immunostimulants b. Immunosuppressant Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars	**08 hours**
Unit V	**5. Principles of toxicology** **a.** Definition and basic knowledge of acute, subacute and chronic toxicity. b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity c. General principles of treatment of poisoning d. Clinical symptoms and management of barbiturates, morphine, organophosphosphorus compound and lead, mercury and arsenic poisoning. **6. Chronopharmacology** a. Definition of rhythm and cycles. b. Biological clock and their significance leading to chronotherapy.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchil Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs. The Point Lippincott Williams &Wilkins
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews-Pharmacology
6. K.D. Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher Modern Pharmacology with clinical Applications, by Charles R. Craig& Robert,
8. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata,
9. Kulkarni SK. Handbook of experimental pharmacology. VallabhPrakashan,
10. N. Udupa and P.D. Gupta, Concepts in Chronopharmacology.

BP608P	PHARMACOLOGY-III (Practical)	4 Hours/Week
1	Dose calculation in pharmacological experiments.	
2	Antiallergic activity by mast cell stabilization assay.	
3	Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS-induced ulcer model.	
4	Study of effect of drugs on gastrointestinal motility.	
5	Effect of agonists and antagonists on guinea pig ileum.	
6	Estimation of serum biochemical parameters by using semi- autoanalyzer.	
7	Effect of saline purgative on frog intestine.	
8	Insulin hypoglycaemic effect in rabbit.	
9	Test for pyrogens (rabbit method)	
10	Determination of acute oral toxicity (LD50) of a drug from a given data.	
11	Determination of acute skin irritation / corrosion of a test substance.	
12	Determination of acute eye irritation / corrosion of a test substance	
13	Calculation of pharmacokinetic parameters from a given data	
14	Biostatistics methods in experimental pharmacology (student's t test, ANOVA)	
15	Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)	
*Experiments are demonstrated by simulated experiments/videos		

BP603T	HERBAL DRUG TECHNOLOGY (Theory)	45 Hours
Scope: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs		
COURSE OUTCOMES		
CO 1	Gain knowledge of the Herbal medicine, principles and practices of biodynamic agriculture, emphasizing holistic and sustainable farming methods.	
CO 2	Learn about the Nutraceuticals including their types, sources, and health benefits and role of nutraceuticals in the prevention and management of various diseases	
CO 3	Develop skills in formulating herbal cosmetic products such as creams, lotions, shampoos ensuring efficacy and stability.	
CO 4	Explain the regulatory requirements, safety considerations and Stability testing of herbal drug drugs	
CO 5	Gain comprehensive knowledge of Schedule T requirements and Good Manufacturing Practices (GMP) specific to the Indian systems of medicine	
COURSE CONTENT		
Unit I	**Herbs as raw materials** Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation, Source of Herbs Selection, identification and authentication of herbal materials, Processing of herbal raw material. **Biodynamic Agriculture** Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. **Indian Systems of Medicine** a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.	**11 hours**
Unit II	**Nutraceuticals** General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. **Study of following herbs as health food:** Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina **Herbal-Drug and Herb-Food Interactions:** General introduction to interaction and classification. Study of the following drugs and their possible side effects and interactions: Hypericum, kava-kava, Ginkgo Biloba, Ginseng, Garlic, Pepper & Ephedra.	**07 hours**

Unit III	**Herbal Cosmetics** Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums, colours, perfumes, protective agents, bleaching agents, and antioxidants in products such as skin care, hair care and oral hygiene products. **Herbal excipients:** Herbal Excipients – Significance of substances of natural origin as excipients – colourants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavours & perfumes. **Herbal formulations:** Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.	**10 hours**
Unit IV	**Evaluation of Drugs** WHO & ICH guidelines for the assessment of herbal drugs stability testing of herbal drugs. **Patenting and Regulatory requirements of natural products:** a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. **Regulatory Issues -** Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.	**10 hours**
Unit V	**General Introduction to Herbal Industry** Herbal drugs industry: Present scope and future prospects. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India. **Schedule T –Good Manufacturing practice of Indian systems of medicine** Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and records.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

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

BP609P	HERBAL DRUG TECHNOLOGY (Practical)	4 Hours/Week
S.No.	**Experiment**	
1	To perform preliminary phytochemical screening of crude drugs.	
2	Determination of the alcohol content of Asava and Arista	
3	Evaluation of excipients of natural origin	
4	Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.	
5	Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.	
6	Monograph analysis of herbal drugs from recent Pharmacopoeias	
7	Determination of Aldehyde content	
8	Determination of Phenol content	
9	Determination of total alkaloids	

BP604T	BIOPHARMACEUTICS AND PHARMACOKINETICS (THEORY)	45 Hours
Scope: This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimens and in solving the problems raised therein.		
COURSE OUTCOMES		
CO 1	Learn about various parameters of drug absorption and distribution.	
CO 2	Gain knowledge on drug elimination and metabolism process. Understand about the bioavailability and bioequivalence studies.	
CO 3	Understand about the various pharmacokinetic models and analyze the pharmacokinetic parameters.	
CO 4	Locating the various pharmacokinetic parameters in multicompartment models.	
CO 5	Assessing the parameters of non-linear pharmacokinetics.	
COURSE CONTENT		
Unit I	**Introduction to Biopharmaceutics** **Absorption**; Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes. **Distribution** Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein binding of drugs	**10 hours**
Unit II	**Elimination:** Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs **Bioavailability and Bioequivalence:** Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.	**10 hours**
Unit III	**Pharmacokinetics:** Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c)Extravascular administrations. Pharmacokinetics parameters - KE, t1/2, Vd, AUC, Ka, Clt and CL_R- definitions methods of eliminations, understanding of their significance and application	**10 hours**

Unit IV	**Multicompartment models:** Two compartment open model. IV bolus. Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.	**10 hours**
Unit V	**Nonlinear Pharmacokinetics:** a. Introduction, b. Factors causing non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with an example of drugs.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi.
2. Biopharmaceutics and Pharmacokinetics; By Robert F Notari
3. Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition, Prentice-Hall Inernational edition.USA
4. Biopharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B. Jaiswal, Vallabh Prakashan Pitampura, Delhi
5. Pharmacokinetics: ByMilo Glbaldi Donald, R. Mercel Dekker Inc.
6. Hand Book of Clinical Pharmacokinetics, ByMilo Gibaldi and Laurie Prescott by ADIS Health Science Press.
7. Biopharmaceutics; By Swarbrick
8. Clinical Pharmacokinetics, Concepts and Applications: ByMalcolm Rowland and
9. Thomas, N. Tozen, Lea and Febrger, Philadelphia, 1995.
10. Dissolution, Bioavailability and Bioequivalence, By Abdou H.M, Mack, Publishing Company, Pennsylvania 1989.
11. Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition
12. Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.
13. Remington's Pharmaceutical Sciences, ByMack Publishing Company, Pennsylvnia

BP605T	PHARMACEUTICAL BIOTECHNOLOGY (Theory)	45 Hrs

Scope:

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

COURSE OUTCOMES

CO 1	Understand the basics of biotechnology, enzyme biotechnology, and genetic engineering in pharmaceutical applications.
CO 2	Apply genetic engineering techniques, including cloning and recombinant DNA technology, in medical applications.
CO 3	Understand immunity types, vaccine production, and the role of hybridoma technology.
CO 4	Understand blotting techniques and microbial genetics, including mutations and transformations.
CO 5	Learn fermentation methods, large-scale production processes, and blood product handling.

COURSE CONTENT

Unit I	**a)** Brief introduction to Biotechnology with reference to Pharmaceutical Sciences. b) Enzyme Biotechnology- Methods of enzyme immobilization and applications. c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries. d) Brief introduction to Protein Engineering. e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase. f) Basic principles of genetic engineering.	**10 hours**
Unit II	a) Study of cloning vectors, restriction endonucleases and DNA ligase. b) Recombinant DNA technology. Application of genetic engineering in medicine. c) Application of r DNA technology and genetic engineering in	**10 hours**

	the production of: i) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin. d) Brief introduction to PCR	
Unit III	Types of immunity- humoral immunity, cellular immunity a) Structure of Immunoglobulins b) Structure and Function of MHC c) Hypersensitivity reactions, Immune stimulation and Immune suppressions. d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity. e) Storage conditions and stability of official vaccines f) Hybridoma technology- Production, Purification and Applications g) Blood products and Plasma Substitutes.	**10 hours**
Unit IV	a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting. b) Genetic organization of Eukaryotes and Prokaryotes c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons. d) Introduction to Microbial biotransformation and applications. e) Mutation: Types of mutation/mutants.	**08 hours**
Unit V	a) Fermentation methods and general requirements, study of media, equipment, sterilization methods, aeration process, stirring. b) Large-scale production fermenter design and its various controls. c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin, d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Computer Application in Pharmacy – William E. Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N. Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi - 110002

BP606T	PHARMACEUTICAL QUALITY ASSURANCE (Theory)	45 Hrs
Scope: This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.		
COURSE OUTCOMES		
CO 1	Understand the principles of quality management systems in the pharmaceutical industry.	
CO 2	Analyze the regulatory requirements and guidelines for pharmaceutical quality assurance.	
CO 3	Evaluate the processes and procedures for Good Manufacturing Practices (GMP).	
CO 4	Explain the principles of validation and qualification in pharmaceutical manufacturing.	
CO 5	Apply quality assurance principles to ensure product quality and documentations for patient safety.	
COURSE CONTENT		
Unit I	**Quality Assurance and Quality Management concepts:** Definition and concept of Quality control, Quality assurance and GMP. **Total Quality Management (TQM):** Definition, elements, philosophies. **ICH Guidelines**: purpose, participants, process of harmonization, Brief overview of QSEM, with special emphasis on Q-series guidelines, ICH stability testing guidelines **Quality by design (QbD):** Definition, overview, elements of QbD program, tools. **ISO 9000 & ISO14000:** Overview, Benefits, Elements, steps for registration **NABL accreditation**: Principles and procedures	**10 hours**
Unit II	**Organization and personnel:** Personnel responsibilities, training, hygiene and personal records. **Premises:** Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination. **Equipment and raw materials:** Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.	**10 hours**
Unit III	**Quality Control:** Quality control test for containers, rubber closures and secondary packing materials. **Good Laboratory Practices:** General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a	**10 hours**

	Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing Facilities	
Unit IV	**Complaints:** Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal. **Document maintenance in pharmaceutical industry:** Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.	**08 hours**
Unit V	**Calibration and Validation:** Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, and validation master plan. Calibration of pH meter, Qualification of UV-visible spectrophotometer, General principles of Analytical method Validation. **Warehousing:** Good warehousing practice, materials management	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guidelines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's – P Sedan Sharma.
6. ISO 9000 and Total QualityManagement – Sadhank G Ghosh
7. The International Pharmacopoeia – Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices – Marcel Deckker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

B. PHARM (SEMESTER – VII)		
BP701T	**INSTRUMENTAL METHODS OF ANALYSIS (Theory)**	**45 Hours**

Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

COURSE OUTCOMES

CO 1	Understand the principles and instrumentation of various analytical techniques.
CO 2	Analyze the applications of spectroscopic methods in pharmaceutical analysis.
CO 3	Evaluate the principles and techniques of chromatographic separation.
CO 4	Explain the principles of sophisticated chromatographic analysis and its applications.
CO 5	Apply instrumental methods in the quantitative and qualitative analysis of drugs.

COURSE CONTENT

Unit I	**UV Visible spectroscopy** Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, Beer and Lambert's law, Derivation and deviations. **Instrumentation -** Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode. **Applications -** Spectrophotometric titrations, Single component and multi component analysis. **Fluorimetry** Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications	**10 hours**
Unit II	**IR spectroscopy** Introduction, fundamental modes of vibrations in polyatomic molecules, sample handling, factors affecting vibrations. Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell, Bolometer, Thermocouple, Thermistor, Pyroelectric detector and applications. **Flame Photometry**-Principle, interferences, instrumentation and	**10 hours**

	applications. **Atomic absorption spectroscopy-** Principle, interferences, instrumentation and applications. **Nepheloturbidometry**- Principle, instrumentation, and applications.	
Unit III	**Introduction to chromatography** **Adsorption and partition column chromatography-** Methodology, advantages, disadvantages and applications. **Thin layer chromatography-** Introduction, Principle, Methodology, Rf values, advantages, disadvantages and applications. **Paper chromatography-**Introduction, methodology, development techniques, advantages, disadvantages and applications. **Electrophoresis**– Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications	**10 hours**
Unit IV	**Gas chromatography-** Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications. **High-performance liquid chromatography (HPLC)** Introduction, theory, instrumentation, advantages and applications.	**08 hours**
Unit V	**Ion exchange chromatography-** Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications. **Gel chromatography-** Introduction, theory, instrumentation and applications. **Affinity chromatography-** Introduction, theory, instrumentation and applications.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Textbook of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Textbook of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP705P	INSTRUMENTAL METHODS OF ANALYSIS (Practical)	4 Hours/Week
S.No.	**Topic**	
1.	Determination of absorption maxima and effect of solvents absorption maxima of organic compounds	
2.	Estimation of dextrose by colorimetry	
3.	Estimation of sulfanilamide by colorimetry	
4.	Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy	
5.	Assay of paracetamol by UV- Spectrophotometry	
6.	Estimation of quinine sulfate by fluorimetry	
7.	Study of quenching of fluorescence	
8.	Determination of sodium by flame photometry	
9.	Determination of potassium by flame photometry	
10.	Determination of chlorides and sulphates by Nepheloturbidometry	
11.	Separation of amino acids by paper chromatography	
12.	Separation of sugars by thin layer chromatography	
13.	Separation of plant pigments by column chromatography	
14.	Demonstration experiment on HPLC	
15.	Demonstration experiment on Gas Chromatography	

BP702T	INDUSTRIAL PHARMACY-II (Theory)	45 Hours
Scope: This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market.		
COURSE OUTCOMES		
CO 1	Analyze the significance of personnel, space, and raw material requirements in pilot plant scale-up processes.	
CO 2	Demonstrate the ability to apply WHO guidelines for technology transfer protocols, including quality risk management and documentation.	
CO 3	Evaluate the historical evolution and current role of regulatory affairs departments and professionals, demonstrating comprehension.	
CO 4	Differentiate between various quality management concepts such as QbD and Six Sigma.	
CO 5	Explaining the responsibilities of CDSCO and State Licensing Authorities and interpreting regulatory requirements for new drugs in India.	
COURSE CONTENT		
Unit I	**Pilot plant scale up techniques:** General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale-up considerations for solids, liquid orals, semi-solids and relevant documentation, SUPAC guidelines, Introduction to platform technology.	**10 hours**
Unit II	**Technology development and transfer: WHO guidelines for Technology Transfer(TT):** Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipment, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues.	**10 hours**
Unit III	**Regulatory affairs**: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals. **Regulatory requirements for drug approval:** Drug Development Teams, Non-Clinical Drug Development,	**10 hours**

	Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.	
Unit IV	**Quality management systems:** Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (QbD), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP.	**08 hours**
Unit V	**Indian Regulatory Requirements:** Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Regulatory Affairs from Wikipedia, the free encyclopedia modified on 7th April available at http://en.wikipedia.org/wiki/Regulatory_ Affairs.
2. International Regulatory Affairs Updates, 2005. available at http://www.iraup.com/about.php
3. Douglas J Pisano and David S. Mantus. Textbook of FDA Regulatory Affairs A Guide for Prescription Drugs, Medical Devices, and Biologics' Second Edition.
4. Regulatory Affairs brought by Learning Plus, inc. available at http.//www.cgmp.com/ra.htm.

BP703T	PHARMACY PRACTICE (Theory)	45 Hours

Scope: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, and patient counselling for improved patient care in the community set up.

COURSE OUTCOMES	
CO 1	Understand hospital structures, the role of hospital pharmacies, and manage adverse drug reactions effectively.
CO 2	Implement drug distribution systems, maintain hospital formularies, and enhance medication adherence and community pharmacy management.
CO 3	Manage pharmacy committees, provide drug information, and counsel patients effectively.
CO 4	Prepare hospital budgets, perform clinical pharmacy functions, and promote rational OTC medication use.
CO 5	Manage drug inventory, understand investigational drugs, and interpret clinical laboratory tests.

COURSE CONTENT		
Unit I	**a) Hospital and it's organization** Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non-clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions. **b) Hospital pharmacy and its organization** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists. **c) Adverse drug reaction** Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following the sudden withdrawal of drugs, Drug interaction-beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.	**10 hours**
Unit II	**a) Drug distribution system in a hospital**	**10 hours**

	Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs. **b) Hospital formulary** Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary. **c) Therapeutic drug monitoring** Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring. **d) Medication adherence** Causes of medication non-adherence, pharmacist role in medication adherence, and monitoring of patient medication adherence. **e) Patient medication history interview** Need for the patient medication history interview, medication interview forms. **f) Community pharmacy management** Financial, materials, staff, and infrastructure requirements.	
Unit III	**a) Pharmacy and therapeutic committee** Organization, functions, and Policies of the pharmacy and therapeutics committee in including drugs in the formulary, inpatient and outpatient prescriptions, automatic stop order, and emergency drug list preparation. **b) Drug information services** Drug and Poison information centre, Sources of drug information, Computerized services, and storage and retrieval of information. **c) Patient counselling:** Definition of patient counselling; steps involved in patient counselling, and Special cases that require the pharmacist **d) Education and training program in the hospital** Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education. **e) Prescribed medication order and communication skills** Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.	**10 hours**
Unit IV	**a) Budget preparation and implementation**	**10 hours**

	b) Clinical Pharmacy Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern. **c) Over the counter (OTC) sales** Introduction and sale of over the counter, and Rational use of common over the counter medications.	
Unit V	**a) Drug store management and inventory control** Organization of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure **b) Investigational use of drugs** Description, principles involved, classification, control, identification, role of a hospital pharmacist, advisory committee. **c) Interpretation of Clinical Laboratory Tests** Blood chemistry, haematology, and urine alysis	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Merchant S.H. and Dr. J.S.Quadry. *A textbook of hospital pharmacy*, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. *A textbook of Clinical Pharmacy Practice- essential concepts and skills,* 1st ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. *Hospital pharmacy*, 5th ed. Philadelphia: Lea & Febiger;1986.
4. Tipnis Bajaj. *Hospital Pharmacy*, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. *Basic skills in interpreting laboratory data*, 4thed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. *Health Education and Community Pharmacy,* 18th ed. India: CBS Publishers & Distributers; 2008.

Journals:

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

BP704T	NOVEL DRUG DELIVERY SYSTEMS (THEORY)	45 Hours
Scope: This subject is designed to impart basic knowledge on the area of novel drug delivery systems.		
COURSE OUTCOMES		
CO 1	Classify and justify the selection of drug candidates for controlled release formulations using diffusion, dissolution, and ion exchange principles.	
CO 2	Evaluate the advantages and disadvantages of microencapsulation and mucosal drug delivery systems.	
CO 3	Compare and contrast different transdermal and gastro retentive drug delivery systems, including formulation approaches and applications.	
CO 4	Assess the advantages and disadvantages of targeted drug delivery systems such as liposomes, niosomes, nanoparticles, and monoclonal antibodies.	
CO 5	Analyze intraocular barriers and methods to overcome them in ocular drug delivery systems, and evaluate the advantages and disadvantages of intrauterine drug delivery systems.	
COURSE CONTENT		
Unit I	**Controlled drug delivery systems:** Introduction, terminology or definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations. **Polymers:** Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.	**10 hours**
Unit II	**Microencapsulation:** Definition, advantages and disadvantages, microspheres /microcapsules, microparticles, methods of microencapsulation, applications. **Mucosal Drug Delivery system:** Introduction, Principles of bio adhesion/mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems. **Implantable Drug Delivery Systems:** Introduction, advantages and disadvantages, concept of implants and osmotic pump	**10 hours**
Unit III	**Transdermal Drug Delivery Systems**: Introduction, Permeation through skin, factors affecting permeation, permeation enhancers, basic components of TDDS, formulation approaches. **Gastro retentive drug delivery systems:** Introduction, advantages, disadvantages, approaches for GRDDS – Floating, high-density systems, inflatable and gastro adhesive systems	**10 hours**

	and their applications **Nasopulmonary drug delivery system:** Introduction to Nasal and Pulmonary routes of drug delivery, Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers.	
Unit IV	**Targeted drug Delivery:** Concepts and approaches advantages and disadvantages, introduction to liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications	**08 hours**
Unit V	**Ocular Drug Delivery Systems:** Introduction, intra ocular barriers and methods to overcome –Preliminary study, ocular formulations and ocuserts. **Intrauterine Drug Delivery Systems:** Introduction, advantages and disadvantages, development of intrauterine devices (IUDs) and applications	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

Journals

6. Indian Journal of Pharmaceutical Sciences (IPA)
7. Indian Drugs (IDMA)
8. Journal of Controlled Release (Elsevier Sciences)
9. Drug Development and Industrial Pharmacy (Marcel & Decker)
10. International Journal of Pharmaceutics (Elsevier Sciences)

B. PHARM (SEMESTER – VIII)		
BP801T	**BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)**	**45 Hours**
Scope: To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non-Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.		
COURSE OUTCOMES		
CO 1	Explain and apply measures of central tendency and measures of dispersion using pharmaceutical examples.	
CO 2	Analyze pharmaceutical data using regression techniques and probability distributions.	
CO 3	Evaluate the appropriateness of non-parametric tests in pharmaceutical research, and design experiments using graphical representations.	
CO 4	Assess blocking and confounding in factorial designs, conduct hypothesis testing in regression models, and apply statistical analysis using tools.	
CO 5	Appraise factorial designs and response surface methodology for pharmaceutical research	
COURSE CONTENT		
Unit I	**Introduction:** Statistics, Biostatistics, Frequency distribution **Measures of central tendency:** Mean, Median, Mode- Pharmaceutical examples **Measures of dispersion:** Dispersion, Range, standard deviation, pharmaceutical problems **Correlation:** Definition, Karl Pearson's coefficient of correlation, Multiple correlation -Pharmaceuticals examples	**10 hours**
Unit II	**Regression:** Curve fitting by the method of least squares, fitting the lines y= a + bx and x= a + by, Multiple regression, standard error of regression– Pharmaceutical Examples **Probability:** Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties - problems Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples	**10 hours**

	Parametric test: t-test (Sample, Pooled or Unpaired and Paired), ANOVA, (One way and Two way), Least Significant difference.	
Unit III	**Non-Parametric tests:** Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Walli's test, Friedman Test **Introduction to Research**: Need for research, Need for design of Experiments, Experiential Design Technique, plagiarism **Graphs**: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph **Designing the methodology**: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, cohort studies, Observational studies, Experimental studies, Designing clinical trials, various phases.	**10 hours**
Unit IV	Blocking and confounding system for Two-level factorials **Regression modelling:** Hypothesis testing in Simple and Multiple regression models **Introduction to Practical components of Industrial and Clinical Trials Problems:** Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online Statistical Software's to Industrial and Clinical Trial Approach.	**08 hours**
Unit V	**Design and Analysis of Experiments:** **Factorial Design:** Definition, 2^2, 2^3design. Advantage of factorial design **Response Surface Methodology:** Central composite design, Historical design, Optimization Techniques	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. New York.
2. Fundamental of Statistics – Himalaya Publishing House- S.C. Gupta
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Panneerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

BP802T	SOCIAL AND PREVENTIVE PHARMACY (Theory)	45 Hours
Scope: The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.		
COURSE OUTCOMES		
CO 1	Understand health and disease concepts, including public health, nutrition, and socio-cultural health factors.	
CO 2	Apply prevention and control methods for infectious and chronic diseases.	
CO 3	Understand key national health programs and their impact.	
CO 4	Evaluate health interventions for specific populations and WHO's role.	
CO 5	Recognize the role of community health services and education.	
COURSE CONTENT		
Unit I	**Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick. **Social and health education**: Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention. **Sociology and health**: Socio-cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health. **Hygiene and health:** personal hygiene and health care; avoidable habits	**10 hours**
Unit II	**Preventive medicine:** General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction and drug substance abuse.	**10 hours**
Unit III	**National health programs, its objectives, functioning and outcome of the following:** HIV AND AIDS control program, TB, Integrated disease surveillance program (IDSP), National leprosy control program, National mental health program, National program for prevention and control of deafness, Universal immunization program, National program for control of blindness, Pulse polio program.	**10 hours**
Unit IV	National health intervention program for mother and child, National family welfare program, National tobacco control	**08 hours**

	program, National Malaria Prevention Program, National program for the health care for the elderly, social health program; role of WHO in Indian national program.	
Unit V	Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

Recommended Journals:

7. Research in Social and Administrative Pharmacy, Elsevier, Ireland

BP803ET	PHARMA MARKETING MANAGEMENT (Theory)	45 Hours
Scope: The pharmaceutical industry not only needs highly qualified researchers, chemists and technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.		
COURSE OUTCOMES		
CO 1	Differentiate between marketing and selling, analyze the marketing environment, and evaluate consumer buying behavior in the pharmaceutical market.	
CO 2	Apply product classification, product life cycle, and product positioning strategies in the pharmaceutical industry.	
CO 3	Justify the selection of promotional methods, determine promotional budgets, and assess the effectiveness of various promotional techniques in the pharmaceutical sector.	
CO 4	Formulate pharmaceutical marketing channel strategies, manage physical distribution effectively, and evaluate the roles and responsibilities of PSRs.	
CO 5	Assess pricing methods, strategies, and issues in price management within the pharmaceutical industry, and analyze emerging concepts like vertical marketing and global marketing.	
COURSE CONTENT		
Unit I	**Marketing:** Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behaviour. **Pharmaceutical market:** Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation& targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.	**10 hours**
Unit II	**Product decision:** Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labelling decisions, Product management in the pharmaceutical industry.	**10 hours**
Unit III	**Promotion:**	**10 hours**

	Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products.	
Unit IV	**Pharmaceutical marketing channels:** Designing channels, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management. **Professional sales representative (PSR):** Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR**.**	**08 hours**
Unit V	**Pricing:** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority). **Emerging concepts in marketing:** Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi

2. Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.

3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill

4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India

5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

6. Ramaswamy, U.S & Nanakamari, S: Marketing Management: Global Perspective, Indian Context, Macmilan India, New Delhi.

7. Shanker, Ravi: Service Marketing, Excell Books, New Delhi

8. Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

BP804ET	PHARMACEUTICAL REGULATORY SCIENCE (THEORY)	45 Hours

Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like the US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

COURSE OUTCOMES

CO 1	Outline the stages of drug discovery and development, including pre-clinical studies and clinical trials.
CO 2	Analyze the regulatory approval processes for Investigational New Drug (IND), New Drug Application (NDA), and Abbreviated New Drug Application (ANDA).
CO 3	Explain the procedures for exporting pharmaceutical products, prepare technical documentation like Drug Master Files (DMF) and Common Technical Documents (CTD), and understand international regulatory requirements such as eCTD and ACTD.
CO 4	Formulate clinical trial protocols, understand the roles of Institutional Review Boards (IRBs) and Independent Ethics Committees, and manage pharmacovigilance and safety monitoring in clinical trials.
CO 5	Differentiate between various regulatory terminologies, guidelines, and laws such as those found in the Orange Book, Federal Register, and other regulatory documents.

COURSE CONTENT

Unit I	**New Drug Discovery and development** Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.	**10 hours**
Unit II	**Regulatory Approval Process** Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA. **Regulatory authorities and agencies** Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)	**10 hours**
Unit III	**Registration of Indian drug product in overseas market** Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD)research.	**10 hours**

Unit IV	**Clinical trials** Developing clinical trial protocols, Institutional Review Board / Independent Ethics committee - formation and working procedures, Informed consent process and procedures, GCP obligations of Investigators, sponsors & Monitors, Managing and Monitoring clinical trials, Pharmacovigilance - safety monitoring in clinical trials	**08 hours**
Unit V	**Regulatory Concepts** Basic terminology, guidance, guidelines, regulations, Laws and Acts, Orange book, Federal Register, Code of Federal Regulatory, Purple book	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Drug Regulatory Affairs by Sachin Itkar, Dr. N.S. Vyawahare, Nirali Prakashan.
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences, Vol.185. Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations by Richard A Guarino, MD, 5th edition, Drugs and the Pharmaceutical Sciences, Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons. Inc.
5. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and biologics /edited by Douglas J. Pisano, David Mantus.
6. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and Isader Kaufer, Marcel Dekker series, Vol.143
7. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance by Fay A. Rozovsky and Rodney K. Adams
8. Principles and Practices of Clinical Research, Second Edition Edited by John I. Gallin and Frederick P. Ognibene
9. Drugs: From Discovery to Approval, Second Edition by Rick Ng

BP805ET	PHARMACOVIGILANCE (THEORY)	45 Hours

Scope: This paper will provide an opportunity for the student to learn about the development of pharmacovigilance as a science, basic terminologies used in pharmacovigilance, the global scenario of Pharmacovigilance, train students on establishing pharmacovigilance program in an organization, various methods that can be used to generate safety data and signal detection. This paper also develops the skills of classifying drugs, diseases and adverse drug reactions.

COURSE OUTCOMES	
CO 1	Understand pharmacovigilance fundamentals and ADR assessment.
CO 2	Apply drug classification and coding for pharmacovigilance.
CO 3	Implement and communicate pharmacovigilance methods.
CO 4	Generate safety data and apply ICH guidelines.
CO 5	Evaluate drug safety for diverse populations using pharmacogenomics.

COURSE CONTENT

Unit I	**Introduction to Pharmacovigilance** • History and development of Pharmacovigilance • Importance of safety monitoring of Medicine • WHO International Drug Monitoring Programme • Pharmacovigilance Program of India (PvPI) **Introduction to adverse drug reactions** • Definitions and classification of ADRs • Detection and reporting • Methods in Causality assessment • Severity and seriousness assessment • Predictability and preventability assessment • Management of adverse drug reactions **Basic terminologies used in pharmacovigilance** • Terminologies of adverse medication related events • Regulatory terminologies	**10 hours**
Unit II	**Drug and disease classification** • Anatomical, therapeutic and chemical classification of drugs • International classification of diseases • Daily defined doses • International Non-proprietary Names for drugs **Drug dictionaries and coding in pharmacovigilance** • WHO adverse reaction terminologies • MedDRA and Standardized MedDRA queries • WHO drug dictionary	**10 hours**

	• Eudravigilance medicinal product dictionary **Information resources in pharmacovigilance** • Basic drug information resources • Specialized resources for ADRs **Establishing pharmacovigilance program** • Establishing in a hospital • Establishment & operation of drug safety department in the industry • Contract Research Organizations (CROs) • Establishing a national programme	
Unit III	**Vaccine safety surveillance** • Vaccine Pharmacovigilance • Vaccination failure • Adverse events following immunization **Pharmacovigilance methods** • Passive surveillance – Spontaneous reports and case series • Stimulated reporting • Active surveillance – Sentinel sites, drug event monitoring and registries • Comparative observational studies – Cross-sectional study, case-control study and cohort study • Targeted clinical investigations **Communication in pharmacovigilance** • Effective communication in Pharmacovigilance • Communication in Drug Safety Crisis management • Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media	**10 hours**
Unit IV	**Safety data generation** • Pre-clinical phase • Clinical phase • Post approval phase (PMS) **ICH Guidelines for Pharmacovigilance** • Organization and objectives of ICH • Expedited reporting • Individual case safety reports • Periodic safety update reports • Post approval expedited reporting • Pharmacovigilance planning • Good clinical practice in pharmacovigilance studies	**08 hours**
Unit V	**Pharmacogenomics of adverse drug reactions** • Genetics related ADR with example focusing PK parameters.	**07 hours**

	Drug safety evaluation in special population • Paediatrics • Pregnancy and lactation • Geriatrics **CIOMS** • CIOMS Working Groups • CIOMS Form **CDSCO (India) and Pharmacovigilance** • D&C Act and Schedule Y • Differences in Indian and global pharmacovigilance requirements	

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones& Bartlett Publishers.
7. Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.
8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills: G. Parthasarathi, Karin Northenden, Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297
13. http://www.ich.org/
14. http://www.cioms.ch/
15. http://cdsco.nic.in/
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

BP806ET	QUALITY CONTROL AND STANDARDIZATION OF HERBALS (THEORY)	45 Hours
Scope: In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.		
COURSE OUTCOMES		
CO 1	Learn the basics of WHO guidelines for making sure herbal drugs are safe and high-quality.	
CO 2	Gain knowledge of the fundamental principles of quality assurance (QA) in the herbal drug industry.	
CO 3	Develop the ability to comply with EU and ICH regulations governing the quality, safety, and efficacy of herbal medicines.	
CO 4	Understand the principles and importance of stability testing to ensure the shelf life and efficacy of herbal medicines.	
CO 5	Apply regulatory requirements and guidelines in the quality control of herbal products.	
COURSE CONTENT		
Unit I	Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms WHO guidelines for quality control of herbal drugs. Evaluation of commercial crude drugs intended for use	**10 hours**
Unit II	**Quality assurance in herbal drug industry** of cGMP, GAP, GMP and GLP in traditional system of medicine. WHO Guidelines on Current Good Manufacturing Practices (cGMP) for Herbal Medicines WHO Guidelines on GACP for Medicinal Plants.	**10 hours**
Unit III	EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines	**10 hours**
Unit IV	Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products. Preparation of documents for new drug application and export registration. GMP requirements and Drugs & Cosmetics Act provisions.	**08 hours**
Unit V	Regulatory requirements for herbal medicines. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems, Comparison of various Herbal Pharmacopoeias. Role of chemical and biological markers in standardization of herbal products.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I, CarrierPub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

BP807ET	COMPUTER AIDED DRUG DESIGN (THEORY)	45 Hours
Scope: This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in the rational drug design process.		
COURSE OUTCOMES		
CO1	Understand the principles and applications of computer-aided drug design (CADD).	
CO2	Analyze molecular modeling techniques for drug discovery and optimization.	
CO3	Evaluate structure-based and ligand-based drug design approaches.	
CO4	Implement computational methods for predicting drug-target interactions.	
CO5	Apply computer-aided drug design tools in rational drug discovery processes.	
COURSE CONTENT		
Unit I	**Introduction to Drug Discovery and Development** Stages of drug discovery and development **Lead discovery and Analog Based Drug Design** Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation. **Analog Based Drug Design:** Bioisosterism, Classification, Bio isosteric replacement. Any three case studies	**10 hours**
Unit II	**Quantitative Structure-Activity Relationship (QSAR)** SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammet's substituent constant and Tafts steric constant. Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.	**10 hours**
Unit III	**Molecular Modeling and virtual screening techniques** **Virtual Screening techniques**: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore-based Screening, **Molecular docking:** Rigid docking, flexible docking, manual docking, Docking based screening. De novo drug design.	**10 hours**
Unit IV	**Informatics & Methods in Drug Design** Introduction to Bioinformatics, cheminformatics. ADME databases, chemical, biochemical and pharmaceutical databases.	**08 hours**
Unit V	**Molecular Modeling:** Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima	**07 hours**

	determination.	

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
4. Foye WO "Principles of Medicinal chemistry 'Lea & Febiger.
5. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

BP808ET	CELL AND MOLECULAR BIOLOGY (THEORY)	45 Hours

Scope:

- Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function.
- This is done both on a microscopic and molecular level.
- Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

COURSE OUTCOMES	
CO1	Understand the fundamental concepts and history of cell and molecular biology, including cell properties and reproduction.
CO2	Comprehend DNA and RNA roles, types, and the processes of transcription and translation.
CO3	Understand protein structure, synthesis, and their role in cellular processes and pathways.
CO4	Analyze genetic principles, the cell cycle, and the processes of mitosis and meiosis.
CO5	Understand cell signaling mechanisms, receptor functions, and the impact of signaling pathway misregulation.

COURSE CONTENT		
Unit I	a) Cell and Molecular Biology: Definitions theory and basics and Applications. b) Cell and Molecular Biology: History and Summation. c) Properties of cells and cell membrane. d) Prokaryotic versus Eukaryotic e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)	**10 hours**
Unit II	a) DNA and the Flow of Molecular Information b) DNA Functioning c) DNA and RNA d) Types of RNA e) Transcription and Translation	**10 hours**
Unit III	a) Proteins: Defined and Amino Acids b) Protein Structure c) Regularities in Protein Pathways d) Cellular Processes e) Positive Control and significance of Protein Synthesis	**10 hours**
Unit IV	a) Science of Genetics b) Transgenics and Genomic Analysis	**08 hours**

	c) Cell Cycle analysis d) Mitosis and Meiosis e) Cellular Activities and Checkpoints	
Unit V	a) Cell Signals: Introduction b) Receptors for Cell Signals c) Signaling Pathways: Overview d) Misregulation of Signaling Pathways e) Protein-Kinases: Functioning	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Peppler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergey manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of recombinant DNA: ASM Press Washington D.C.
13. RA Goldshy et. al., : Kuby Immunology.

BP809ET	COSMETIC SCIENCE (THEORY)	45 Hours
Scope:		
COURSE OUTCOMES		
CO1	Classify cosmetic products based on regulatory definitions, explain the evolution of cosmeceuticals, and categorize cosmetic excipients by their functions.	
CO2	Analyze the formulation principles and advantages/disadvantages of skin care, hair care, and oral care products.	
CO3	Evaluate sunscreens based on SPF classification, assess the role of herbs in cosmetic formulations, and apply BIS specifications and analytical methods for cosmetic products.	
CO4	Assess cosmetic efficacy using tools like sebumeter and corneometer, measure parameters and evaluate the benefits of soaps and syndet bars.	
CO5	Analyze causes of oily and dry skin, evaluate cosmetic issues and assess skincare concerns.	
COURSE CONTENT		
Unit I	Classification of cosmetic and cosmeceutical products Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs **Cosmetic excipients:** Surfactants, rheology modifiers, humectants, emollients, preservatives. Classification and application **Skin**: Basic structure and function of skin. **Hair**: Basic structure of hair. Hair growth cycle. **Oral Cavity**: A common problem associated with teeth and gums.	**10 hours**
Unit II	**Principles of formulation and building blocks of skin care products:** Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in the formulation of cosmeceuticals. **Antiperspirants & deodorants**- Actives & mechanism of action. **Principles of formulation and building blocks of Hair care products:** Conditioning shampoo, Hair conditioner, anti-dandruff shampoo, Hair oils. Chemistry and formulation of Para-phenylene diamine-based hair dye. **Principles of formulation and building blocks of oral care products:** Toothpaste for bleeding gums, and sensitive teeth. Teeth whitening, Mouthwash.	**10 hours**

Unit III	Sun protection, Classification of Sunscreens and SPF. **Role of herbs in cosmetics:** Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove Analytical cosmetics: BIS specification and analytical methods for shampoo, skin cream and toothpaste.	**10 hours**
Unit IV	Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.	**08 hours**
Unit V	Oily and dry skin, causes leading to dry skin, skin moisturization. Basic understanding of the terms Comedogenic, and dermatitis. Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor. Antiperspirants and Deodorants- Actives and mechanism of action	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
2. Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition, Vandana Publications Pvt. Ltd., Delhi.
3. Text book of cosmeticology by Sanju Nanda & Roop K. Khar, Tata Publishers.

BP810ET	PHARMACOLOGICAL SCREENING METHODS (THEORY)	45 Hours
Scope: This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.		
COURSE OUTCOMES		
CO1	Understand guidelines and techniques for using laboratory animals.	
CO2	Apply models to evaluate CNS drug effects.	
CO3	Use models to study ANS drug effects.	
CO4	Evaluate models for CVS and other drug effects.	
CO5	Develop research skills and analyze data statistically.	
COURSE CONTENT		
Unit I	**Laboratory Animals:** Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains of animals. Popular transgenic and mutant animals. Techniques for collection of blood and common routes of drug administration in laboratory animals, Techniques of blood collection and euthanasia.	**08 hours**
Unit II	**Preclinical screening models** **a.** Introduction: Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study. **b. Study of screening animal models for** Diuretics, nootropics, anti-Parkinson's, antiasthmatics, **Preclinical screening models:** for CNS activity- analgesic, antipyretic, anti-inflammatory, general anesthetics, sedative and hypnotics, antipsychotics, antidepressants, antiepileptics, anti-parkinsonism, Alzheimer's disease	**10 hours**
Unit III	**Preclinical screening models:** for ANS activity, sympathomimetics, sympatholytic, parasympathomimetics, parasympatholytic, skeletal muscle relaxants, drugs acting on eye, local anesthetics	**10 hours**
Unit IV	**Preclinical screening models**: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslepidemic, anti-aggregatory, coagulants, and anticoagulants Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.	**10 hours**
Unit V	**Research methodology and Bio-statistics**	**07 hours**

	Selection of research topic, review of literature, research hypothesis and study design Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA. Graphical representation of data	

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Fundamentals of experimental Pharmacology-byM.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulkarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

BP811ET	ADVANCED INSTRUMENTATION TECHNIQUES (THEORY)	45 Hours
Scope: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.		
COURSE OUTCOMES		
CO1	Understand principles, instrumentation, and applications of NMR and Mass Spectrometry.	
CO2	Analyze thermal and X-ray diffraction methods, including their principles, instrumentation, and applications.	
CO3	Perform calibration and validation of various analytical instruments as per ICH and USFDA guidelines.	
CO4	Apply principles and techniques of radioimmune assays and extraction methods for drug analysis.	
CO5	Utilize advanced hyphenated techniques (LC-MS/MS, GC-MS/MS, HPTLC-MS) for qualitative and quantitative drug analysis.	
COURSE CONTENT		
Unit I	**Nuclear Magnetic Resonance spectroscopy** Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications **Mass Spectrometry-** Principles, Fragmentation, Ionization techniques –Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications	**10 hours**
Unit II	**Thermal Methods of Analysis**: Principles, instrumentation and applications of thermogravimetric analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) **X-Ray Diffraction Methods:** Origin of X-rays, basic aspects of crystals, Xray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.	**10 hours**
Unit III	**Calibration and validation**-as per ICH and USFDA guidelines **Calibration of following Instruments** Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer Fluorimeter, Flame Photometer, HPLC and GC	**10 hours**
Unit IV	**Radio immunoassay:** Importance, various components,	**08 hours**

	Principle, different methods, Limitation and Applications of Radio immunoassay **Extraction techniques**: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction	
Unit V	**Hyphenated techniques**-LC-MS/MS, GC-MS/MS, HPTLC-MS.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy byWilliam Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

BP812ET	DIETARY SUPPLEMENTS AND NUTRACEUTICALS (THEORY)	45 Hours
Scope: This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.		
COURSE OUTCOMES		
CO1	Develop a clear understanding of functional foods, nutraceuticals, and dietary supplements, including their definitions and distinctions.	
CO2	Gain a comprehensive understanding of phytochemicals as bioactive Compounds found in plants, distinct from traditional nutrients.	
CO3	Learn a comprehensive understanding of free radicals and ROS as molecules with unpaired electrons, leading to high reactivity.	
CO4	Gain a comprehensive understanding of free radicals, their formation, biological effects, and implications across various health and disease contexts.	
CO5	Apply regulatory knowledge to assess food safety practices in production, processing, and distribution.	
COURSE CONTENT		
Unit I	a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc. b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in the community. c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of the following used as nutraceuticals/functional foods: Spirulina, Soybean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds	**07 hours**
Unit II	**Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following** a) Carotenoids- α and β-Carotene, Lycopene, Xanthophylls, leutin b) Sulfides: Diallyl sulfides, Allyl trisulfide. c) Polyphenolics: Reservetrol d) Flavonoids- Rutin, Naringin, Quercitin, Anthocyanidins, catechins, Flavones e) Prebiotics/Probiotics.: Fructooligosaccharides, Lactobacillus f) Phyto estrogens: Isoflavones, daidzein, Geebustin, lignans g) Tocopherols h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.	**15 hours**

Unit III	a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, and nucleic acids. b) Dietary fibres and complex carbohydrates as functional food ingredients.	**07 hours**
Unit IV	a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals' involvement in other disorders. Free radicals' theory of ageing. b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathion Vitamin C, Vitamin E, α- Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole. c) Functional foods for chronic disease prevention	**10 hours**
Unit V	a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals. b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods. c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.	**06 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Dietetics by Sri Lakshmi
2. Role of dietary fibres and neutraceuticals in preventing diseases by K. T Agusti and P. Faizal: BSPunblication.
3. Advanced Nutritional Therapies by Cooper. K.A., (1996).
4. The Food Pharmacy by Jean Carper, Simon & Schuster, UK Ltd., (1988).
5. Prescription for Nutritional Healing by James F. Balch and Phyllis A. Balch 2nd Edn., Avery Publishing Group, NY (1997).
6. G. Gibson and C. Williams Editors 2000 Functional foods Woodhead Publ.Co. London.
7. Goldberg, I. Functional Foods. 1994. Chapman and Hall, New York.
8. Labuza, T.P. 2000 Functional Foods and Dietary Supplements: Safety, Good Manufacturing Practice (GMPs) and Shelf-Life Testing in Essentials of Functional Foods M.K. Sachmidl and T.P. Labuza eds. Aspen Press.
9. Handbook of Nutraceuticals and Functional Foods, Third Edition (Modern Nutrition)
10. Shils, ME, Olson, JA, Shike, Shike, M. 1994 Modern Nutrition in Health and Disease. Eighth edition. Lea and Febiger

BP813ET	Pharmaceutical Product Development (THEORY)	45 Hours
Scope: This subject covers foundational topic that are important for understanding the need and requirements of dietary supplements among different groups in the population.		
COURSE OUTCOMES		
CO1	Outline the objectives and regulations governing pre-formulation, formulation development, stability assessment, manufacturing, and quality control testing of various dosage forms.	
CO2	Learners will demonstrate specialized knowledge of pharmaceutical excipients.	
CO3	Analyze the tablet, capsule, parenteral, aerosol products and novel drug delivery systems (NDDS) excipients.	
CO4	Apply various optimization techniques such as factorial designs and Quality by Design (QbD) principles in pharmaceutical product development.	
CO5	Assess the selection and quality control testing of packaging materials for pharmaceutical products, considering regulatory considerations.	
COURSE CONTENT		
Unit I	Introduction to pharmaceutical product development, objectives, regulations related to preformulation, formulation development, stability assessment, manufacturing and quality control testing of different types of dosage forms	**10 hours**
Unit II	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Solvents and solubilizers ii. Cyclodextrins and their applications iii. Non-ionic surfactants and their applications iv. Polyethylene glycols and sorbitol v. Suspending and emulsifying agent vi. Semi solid excipients	**10 hours**
Unit III	An advanced study of Pharmaceutical Excipients in pharmaceutical product development with a special reference to the following categories i. Tablet and capsule excipients ii. Directly compressible vehicles iii. Coat materials iv. Excipients in parenteral and aerosols products v. Excipients for formulation of NDDS Selection and application of excipients in pharmaceutical formulations with specific industrial applications	**10 hours**
Unit IV	Optimization techniques in pharmaceutical product development. A study of various optimization techniques for	**08 hours**

	pharmaceutical product development with specific examples. Optimization by factorial designs and their applications. A study of QbD and its application in pharmaceutical product development.	
Unit V	Selection and quality control testing of packaging materials for pharmaceutical product development- regulatory considerations.	**07 hours**

RECOMMENDED BOOKS (LATEST EDITIONS)

1. Pharmaceutical statistics practical and clinical applications by Stanford Bolton, Charlesbon; Marcel Dekker inc.
2. Encyclopedia of pharmaceutical technology, edited by James Swarbrick, third Edition, Informa healthcare publishers.
3. Pharmaceutical dosage forms, tablets, volume ii, edited by Herbert a. Lieberman Andleon Lachman; Marcel Dekker, inc.
4. The theory and practice of industrial pharmacy, fourth edition, edited by Roop Khar, S P Vyas, Farhan J Ahmad, Gaurav K Jain; CBS publishers and distributors Pvt. ltd. 2013.
5. Martin's physical pharmacy and pharmaceutical sciences, fifth edition, edited by Patrick j. Sinko, bi publications pvt. Ltd.
6. Targeted and controlled drug delivery, novel carrier systems by s. P. Vyas and R. K. Khar, CBS publishers and distributors pvt. Ltd, first edition 2012.
7. Pharmaceutical dosage forms and drug delivery systems, Loyd v. Allen jr., Nicholas B. POPOVICH, Howard c. Ansel, 9th ed. 40
8. Aulton's pharmaceutics – the design and manufacture of medicines, Michael e. Aulton, 3rd ed.
9. Remington – the science and practice of pharmacy, 20th ed.
10. Pharmaceutical dosage forms – tablets vol 1 to 3, a. Liberman, Leon Lachman Andjoseph B. Schwartz
11. Pharmaceutical dosage forms – disperse systems vol 1 to 3, H.A. Liberman, Martin, M.R and Gilbert S. Banker.
12. Pharmaceutical dosage forms – parenteral medication vol 1 & 2, Kenneth e. Avis Andh.A. Libermann.
13. Advanced review articles related to the topics